MAR 01 1991 0631 0447 I 53.2: Ar 2/5

DISTRIBUTIONAL SURVEY AND EXCAVATION OF ARCHAEOLOGICAL LANDSCAPES IN THE VICINITY OF EL PASO, TEXAS

REPORT PREPARED FOR THE
LAS CRUCES DISTRICT OFFICE OF THE
BUREAU OF LAND MANAGEMENT

OCTOBER 1988

Hgw

BLM-NM-GI-88-024-3120

DISTRIBUTIONAL SURVEY AND EXCAVATION OF ARCHAEOLOGICAL LANDSCAPES IN THE VICINITY OF EL PASO, TEXAS

by Eileen L. Camilli, LuAnn Wandsnider and James I. Ebert

with Contributions by

Barbara J. Mills
John R. Roney
David C. Simons
Anna Backer
Thomas C. O'Laughlin
Linda J. Scott
Christopher M. Stevenson
Jeanne Schutt
Signa L. Larralde
and Fred Nials

OCTOBER 1988

TABLE OF CONTENTS

Page

CHAPTER 1 - DISTRIBUTIONAL SURVEY ON THE WEST MESA

- DISTRIBUTIONAL SURVEY ON THE WEST MESA 1-2
- REPORT SUMMARY 1-6

CHAPTER 2 - NATURAL LANDSCAPE AND ENVIRONMENT: DESCRIPTION AND INTERPRETATION

- REGIONAL PHYSIOGRAPHY 2-1
- SURVEY AREA LANDFORMS AND VEGETATION 2-3
- PALEOCLIMATE 2-7
- HISTORICAL CHANGES IN VEGETATION 2-9
- SURFACE DYNAMICS OF THE STUDY AREA AND THEIR ARCHAEOLOGICAL SIGNIFICANCE 2-10
  - Davis and Nials Interpretation 2-11
  - A Reinterpretation 2-12
  - The Surface and Subsurface Dynamics of the Study Area 2-13
  - Re-Photointerpretation 2-13
  - Reinterpretation of Archaeological Relevance 2-14

CHAPTER 3 - EXPLANATORY DIRECTIONS IN EL PASO ARCHAEOLOGY: A SHORT HISTORY AND EVALUATION

- THE CULTURE HISTORY OF THE STUDY AREA: A MICROCOSM OF AMERICAN ARCHAEOLOGY 3-1
- A TAXONOMY OF EL PASO REGION CULTURAL HISTORIES 3-3
- THE BEGINNINGS OF EL PASO ARCHAEOLOGY: CULTURAL INTERACTIONS AND RELATIONSHIPS 3-3
- CULTURAL - EVOLUTIONARY EXPLANATIONS 3-5
- CULTURAL - EVOLUTIONARY EXPLANATIONS AND EL PASO AREA ARCHAEOLOGY: A DISCUSSION AND EVALUATION 3-11
  - Unoperational Field Methods 3-11
  - Unrealistic Recording of Site Attributes?: Enormous Sizes . . 3-12
  - Sample Size and Cultural - Evolutionary Explanations 3-13
  - Temporal and Functional Diagnostics 3-13
  - Definitions of Site Functions and Use 3-14
  - In Search of, and Defining, Residences 3-15
  - Evaluating Cultural Evolutionary Explanations and Formative Sequences in the El Paso Area 3-16
  - Evaluating Cultural Evolutionary Explanations 3-16
  - El Paso Area Environmental and Subsistence System Explanations 3-17
  - Distributional Archaeological Approaches 3-18
  - An Evaluation of the Arizona State Museum Distributional Survey 3-21
- THE ETHNOGRAPHIC RECORD AND ITS RELEVANCE TO THE ARCHAEOLOGY OF THE EL PASO AREA 3-23
  - Land Use Strategies and Occupational Histories 3-23
  - Basin and Range Settlement and Mobility Observations and Interpretations 3-26
- OBSERVATIONS AND INTERPRETATIONS PERTAINING TO TECHNOLOGY 3-33

TABLE OF CONTENTS (continued)

Page

SYSTEMS AND THEIR COMPONENTS AS SUGGESTED BY THE ETHNOHISTORIC AND ETHNOGRAPHIC RECORDS 3-34
Subsistence and Subsistence Strategies -- Hunting and Gathering Systems 3-34
Settlement and Mobility - Hunting and Gathering Systems . . . 3-35
Subsistence and Settlement Strategies - Agricultural Systems . 3-36
Settlement and Mobility - Agricultural Systems 3-36
Ethnographic and Historical Observations in the El Paso Region 3-37
Ethnographic Observations and their Potential Archaeological Significance 3-39

CHAPTER 4 - ARCHAEOLOGICAL RECONNAISSANCE AND DISTRIBUTIONAL SURVEY FOR THE NAVAJO-HOPI LAND EXCHANGE PROJECT IN NEW MEXICO

PREVIOUS WORK IN THE NAVAHO - HOPI LAND EXCHANGE AREA by Signa L. Larralde 4-1
PHASE I SURVEY 4-3
Phase I Survey Procedures 4-3
Phase I Survey Results 4-8
PATENT RESTRICTIONS
PHASE II SURVEY by Eileen Camilli, James I. Ebert, Signa L. Larralde, LuAnn Wandsnider 4-31
The Phase II Sample 4-31
Phase II Survey Procedures 4-33
PHASE II SURVEY RESULTS 4-35
Artifact Distributions in Phase II Survey Units 4-35
Comparison of Phase I, Phase II, and Conventional Survey Results 4-49
Spatial Associations in Phase II Survey Units 4-52

CHAPTER 5 - AN ASSESSMENT OF THE SPATIAL ACCURACY AND DESCRIPTIVE PRECISION OF THE DISTRIBUTIONAL DATA BASE

DISCOVERY ACCURACY 5-1
Artifact Discovery Accuracy 5-3
Discovery Accuracy: Implications and Conclusions 5-31
ARTIFACT CODING PRECISION 5-32
Experienced Analysts 5-41
Inexperienced Analysts 5-51
Descriptive Precision: Implications and Conclusions 5-56
CONCLUSIONS 5-60

CHAPTER 6 - LITHIC TOOL PRODUCTION, RECYCLING, AND USE

MEASUREMENT AND CODING OF ARTIFACT ATTRIBUTES 6-1
Record for all Lithics 6-1
Record for Tools 6-3
Record for Projectile Points Only 6-3
Record for Groundstone 6-3
CHIPPED STONE AND GROUNDSTONE ASSEMBLAGES 6-4
Lithic Raw Material Resources 6-7

TABLE OF CONTENTS (continued)

Page

Models of Differential Raw Material Selections 6-9
Accommodating Tool Production to Patterns of Group Movement 6-11
Material Type Composition of Mountain Periphery and Desert Basin Assemblages 6-12
Material Types in Period and Phase Categories 6-12
Material Type Variety in Period and Phase Categories 6-18
Shifts in Production Technique and Technological Options . . . 6-19
Flake Attributes 6-20
Morphology and Use of Cores and Formal Tools 6-40
Patterns of Assemblage Content 6-47
Projectile Point Descriptions 6-47
Groundstone Artifacts 6-48
Groundstone in Cultural Periods and Phases 6-62

CHAPTER 7 - CERAMIC RECORDING PROCEDURES AND DESCRIPTIONS

CERAMIC RECORDING PROCEDURES by Barbara J. Mills 7-1
Descriptions of Ceramic Attributes Recorded 7-1
CERAMICS IN PHASE II SURVEY UNITS 7-9

CHAPTER 8 - SPATIAL ANALYSIS OF THE DISTRIBUTIONAL DATA BASE

OCCUPATIONAL HISTORIES OF LOW DENSITY DISTRIBUTIONS ON THE WEST MESA SCARP 8-1
Lithic Artifact Taxonomy 8-2
Methods 8-3
SVD Analysis Conclusions 8-17
ANALYSIS OF SPATIAL ASSOCIATION CONTENT 8-17
Methods 8-18
Lithic, Ceramic, and Feature Content of Grouped Spatial Association 8-18
Cluster Interpretations 8-25
SUMMARY 8-30
Differential Visibility of Archaeological Surface Material . . 8-30

CHAPTER 9 - SURVEYED AND EXCAVATED FEATURES

EXCAVATED FEATURE DESCRIPTIONS, by John R. Roney and David C. Simons 9-3
Pit Structures and Associated Features 9-3
RADIOCARBON DETERMINATIONS 9-13
OBSIDIAN HYDRATION DATING 9-40
ANALYTICAL PROCEDURES AND RESULTS 9-42
Correspondences Between Radiocarbon and Hydration Band Widths 9-42
MACROFLORAL AND FAUNAL REMAINS 9-44
EXCAVATED ARTIFACTS 9-47
SURVEYED FEATURES AND ASSOCIATED SURFACE ARTIFACTS 9-49
Surficial Artifact Assemblages at Features 9-55

TABLE OF CONTENTS (continued)

Page

Feature Assemblage and Feature Type Correlations 9-61

COMPARISON OF SURFACE AND SUBSURFACE ARTIFACT ASSEMBLAGES FOR SELECT FEATURES 9-68

CHAPTER 10 - CONCLUSIONS: AN APPROACH TO NON-EPISODIC INTERPRETATIONS OF THE CONTINUOUS ARCHAEOLOGICAL RECORD

CHAPTER SUMMARIES 10-2

APPENDICES

Appendix A - GEOMORPHOLOGICAL STRATIFICATION by Fred Nials A-1

Appendix B - PHASE I SURVEY FIELD FORMS AND PHASE II SURVEY PROCEDURES AND SURVEY FIELD FORMS B-1

Appendix C - EVALUATION OF PREHISTORIC LOCI by John R. Roney C-1

Appendix D - SURVEY AREAS 1 AND 2: PARCELS UNDER PATENT RESTRICTION . D-1

Appendix E - PHASE II DISCOVERY DATA E-1

Appendix F - ASSEMBLAGE SUMMARIES FOR SURVEY UNITS F-1

Appendix G - FLOTATION SAMPLES AND MACROFLORAL REMAINS G-1

Appendix H - POLLEN ANALYSIS by Linda J. Scott H-1

REFERENCES R-1

TABLES

TABLE

1.1 Compilation and Comparison of Effort for Completing Distributional Survey Tasks 1-3

4.1 Area (Hectares/Acres) and Transecting Methods by Survey Area 4-4

4.2 Size and Distribution of Survey Units 4-8

4.3 Total Artifact and Feature Counts in Each Survey Area 4-9

4.4 Artifact and Feature Counts Standardized by LTMS for Survey Areas 4-9

4.5a Survey Units in Area 1 and 2 Clusters 4-21

4.5b Survey Units in Area 3 Clusters 4-22

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE Page

4.6a Area 1 and 2 Cluster Statistics 4-23

4.6b Area 3 Cluster Statistics 4-23

4.7 Survey Units Identified for Application of Patent Restrictions 4-28

4.8 Archaeological and Historical Remains in Parcels Under Patent Restriction 4-29

4.9a Areas 1 and 2 Sample Population 4-32

4.9b Area 3 Sample Population 4-32

4.10 Phase II Sample Units 4-33

4.11 Discovered Artifact Frequencies in Phase II Survey Units . . . 4-36

4.12 Discovered Features In Phase II Survey Units 4-36

4.13 Comparisons of Phase I and Phase II Artifact Counts 4-50

4.14 Comparisons of Conventional Survey Data with Artifact Frequencies Documented Through Phase I and II Techniques. . 4-53

4.15 Summary Statistics of Spatial Cluster Attributes by Unit . . 4-54

5.1 Percent Artifacts Recovered by Crew 5-2

5.2 Dates that Units were Surveyed and Analyzed and the Amount of Time Elapsing Between the Two 5-4

5.3 Units and Sweeps Included in Discovery Accuracy Analysis . . . 5-5

5.4 Color Assignments for Lithic Material Types 5-10

5.5 Percent Artifacts Flagged In Orange According to Artifact Class and Artifact Color 5-11

5.6 Cross Tabulation of the Percentage of Artifacts Flagged in Orange According to Size Class and Color 5-12

5.7 Percentage of Artifacts Flagged In Orange According to Relative Sweep Artifact Density 5-14

5.8 Cross-Tabulation of Artifact Discovery Rate According to Artifact Size and Coloration for Low Artifact Density Sweeps 5-14

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE		Page
5.9	Chi-Square Values Evluating the Cross-Tabulation of Completed Sweeps by Environmental Value and Sweep Density	5-17
5.10	Artifact Discovery Rates According to Inferred Temperature at the Time the Sweep was Completed	5-20
5.11	Artifact Discovery Rates According to the Light Quality Recorded by the Discovery Crew Chief in the Field at the Completetion of every 4 Sweeps	5-21
5.12	Artifact Discovery Rates According to the Hour by which the Sweep had been Completed as Recorded by the Discovery Crew Chief In the Field	5-22
5.13	Artifact Discovery Rates According to the Wind Intensity Recorded by the Discovery Crew Chief in the Field at the Completion of Every 4 Sweeps	5-23
5.14	Mean Sweep Tally Percentage by Survey Crew Member as Calculated from Discovery Forms	5-25
5.15	Daily Artifact Discovery Percentages for those Discovery Crew Members who Surveyed 2 or More Days	5-28
5.16	Artifact Discovery Percentages for Discovery Crew Members who Surveyed 2 or More Days by the Time of Day the Transect was Completed	5-28
5.17	Distribution of Chipped Stone Raw Material Type Codes Among Principal Lithic Analysts for NHLEP Chipped Stone Data Base	5-33
5.18	Distribution of Chipped Stone Type Codes Among Principal Lithic Analysts for NHLEP Chipped Stone Data Base	5-35
5.19	Distribution of a) Angular Debris and Flakes (Distal and Proximal), and b) Angular Debris, Distal Flakes Fragments, and Platform-bearing Flakes According to Coder Experience .	5-36
5.20	Distribution of Chipped Stone Flake Debitage Edge Utilization/ Modification/Accessorization Codes Among Principal Lithic Analysts for Navajo-Hopi Chipped Stone Data Base	5-37
5.21	Chi-Square Evaluation of Distribution of Edge Utilization/Modification Codes Among Experienced and Inexperienced Lithic Analysts in Terms of 1) Presence/Absence of Modification and b) Kind of Modification	5-38

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE Page

5.22 Number of Different Material Type Codes Coded by 7 Coders for 26 Possible Material Types and 6 Collapsed Material Type Categories 5-40

5.23 Summary of Chipped Stone Coding Consistency by Coder Experience and Chipped Stone Code 5-42

5.24 Analysis of Variance and Tukey's Studentized Range Test for Continuous Chipped Stone Variables Comparing Experienced Coders 5-43

5.25 Distribution of Gross Material Type Codes Among Experienced Coders within Test Assemblage 5-44

5.26 Distribution of Chipped Stone Codes Among Expereienced Coders within Test Assemblage 5-45

5.27 Distribution of Chipped Stone Type Codes by Coder 5-46

5.28 Number of Chipped Stone Types Coded by Experienced Analysts, for Those Test Artifacts Coded as a Core, Uniface, or Biface by One of the Three Coders, Considered by Material Type . . 5-48

5.29 Distribution of Functional Core (Core, Uniface 0-2, and Biface 0-2), Uniface 3 and Biface 3 Types Among Experienced Coders Within Navajo-Hopi Chipped Stone Data Base. 5-48

5.30 Distribution of Flake Completeness Codes Among Experienced Coders Within Test Assemblage 5-48

5.31 Distribution of Flake Platform Codes Among Experienced Coders Within Test Assemblage 5-49

5.32 Distribution of Platform Codes by Coder 5-49

5.33 Number of Platform Codes Recorded by Experienced Analysts, for Those Test Artifacts for Which a Platform was Coded, Considered by Material Type 5-50

5.34 Distribution of Distal Cortex Codes Among Experienced Coders Within Test Assemblage. 5-50

5.35 Distribution of Edge Utilization/Modification Codes Among Experienced Coders Within Test Assemblages 5-50

5.36 Analysis of Variance and Tukey's Studentized Range Test for Continuous Chipped Stone Variables for all Coders with the Mean of Values for Experienced Coders 5-52

TABLES (continued)

TABLE — Page

5.37 Analysis of Variance and Tukey's Studentized Range Test Comparing Dorsal Scar Counts Between the Experienced Coders and all other Coders 5-52

5.38 Distribution of Gross Material Type Codes Among Inexperienced (In Comparison with Experienced Analyst) Within Test Assemblage 5-54

5.39 Distribution of Chipped Stone Type Codes Among Inexperienced (in Comparison with Experienced Analyst) Within Test Assemblage 5-54

5.40 Distribution of Flake Completeness Codes Among Inexperienced (in Comparison with Experienced Analyst) Within Test Assemblage 5-55

5.41 Distribution of Flake Platform Codes Among Inexperienced (in Comparison with Experienced Analyst) Within Test Assemblage 5-57

5.42 Distribution of Flake Dorsal Cortex Codes Among Inexperienced (In Comparison with Experienced Analyst) Within Test Assemblage 5-57

5.43 Distribution of Edge Utilization/Modification Codes Among Inexperienced (in Comparison with Experienced Analyst) Within Test Assemblage 5-58

5.44 Percent of Artifacts Coded as having Fire-alteration by Experienced and Inexperienced Analysts. 5-58

6.1a Chipped Stone Type Frequencies in 400 x 400 Meter Survey Units 6-5

6.1b Chipped Stone Type Frequencies in 800 x 800 Meter Survey Units 6-5

6.2a Groundstone Type Frequencies in 400 x 400 Meter Survey Units 6-5

6.2b Groundstone Type Frequencies in 800 x 800 Meter Survey Units 6-5

6.3 West Mesa Assemblage Summary 6-6

6.4 Selected Material Type Proportions in Summed Assemblages from the West Mesa and Keystone Dam Areas 6-12

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE		Page
6.5	Classified Artifact Clusters	6-13
6.6	Chipped Stone Type Percentages in General Material Type Categories	6-15
6.7	Chipped Stone Material Type Percentages for Periods and Phases	6-16
6.8	Chipped Stone tool and Material Type Percentages in Segregated Assemblages	6-17
6.9a	Mean Material Type Variety and Number of Flakes and Angular Debris for Spatial Associations in Period and Phase Categories	6-19
6.9b	Mean Material Type Variety and Number of Cores for Spatial Associations in Period and Phase Categories	6-19
6.10	Flake Cortex and Dorsal Scar Attributes for the West Mesa Flake Assemblage	6-22
6.11	Flake Cortex Cover and Platform Characteristics	6-22
6.12	Cross Tabulation of NHLEP Unutilized Flake Material Type By Size Class	6-23
6.13	Cross Tabulation of NHLEP Utilized Flake Material Type by Size Class	6-24
6.14a	Cross Tabulation of Material Types and General Size Class for all Cores as Defined by O'Laughlin (1980)	6-26
6.14b	Comparison of NHLEP and KEYSTONE Core Size by Material Type .	6-26
6.15	Distribution of Unutilized Chert Flake Size by Periods and Phases	6-26
6.16	Percentages of Cortical and Non-Cortical Flakes in West Mesa and Keystone Dam Sites 33 and 34 Assemblages	6-28
6.17	Distribution of Chert Flakes in Cortex Classes for Assemblages Assigned to Period and Phase Categories	6-29
6.18	Distribution of Crystalline Volcanic Flakes in Cortex Classes for Assemblages Assigned to Period and Phase Categories	6-29
6.19	Distribution of Quartzite Flakes in Cortex Classes	6-30

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE Page

6.20 Distribution of Unutilized Glassy Volcanic Flakes in Cortex Classes for Assemblages Assigned to Period and Phase Categories 6-30

6.21 Distribution of Utilized Flakes in Material Type and Cortex Classes 6-30

6.22 Distribution of Utilized Chert Flakes in Cortex Classes for Assemblages Assigned to Period and Phase Categories . . 6-31

6.23 Distribution of Utilized Crystalline Volcanic Flakes in Cortex Classes for Assemblages Assigned to Period and Phase Categories 6-31

6.24 a&b Distribution of Unutilized Flakes in Platform Classes Material Types 6-31

6.25 West Mesa and Keystone Dam Sites 33 and 34 Flake Percentages with Cortical and Non-Cortical Platforms 6-32

6.26a Platform Category by Period and Phase for Unutilized Chert Flakes 6-33

6.26b Platform Category by Period and Phase for Unutilized Crystalline Volcanic Flakes 6-33

6.26c Platform Category by Period and Phase for Unutilized Quartzite Flakes 6-33

6.26d Platform Category by Period and Phase for Unutilized Glassy Volcanic Flakes 6-33

6.27 Variable Values used to Calculate STAGE 6-34

6.28 Mean Flake Attribute Values by Material Type 6-37

6.29 Mean Stage of Undifferentiated, Biface Thinning, and Pressure Flakes for Main Material Types 6-38

6.30 Mean Flake Attribute Values by Period and Phase 6-39

6.31 Flake Stage by Material Type for Spatial Associations 6-40

6.32 Mean Attribute Measure for Obsidian Flakes 6-40

6.33 Obsidian Artifact Types in the West Mesa Assemblage 6-41

6.34 Uniface Functional Edges by Angle and Material Type 6-42

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE Page

6.35 Uniface Functional Edges by Edge Angle and Edge Modification . 6-42

6.36a Uniface Length Comparison 6-43

6.36b Uniface Edge Angle Comparisons 6-43

6.37 Core and Uniface Size Classes 6-43

6.38 Core and Formal Tool Classes by Cortex Cover 6-44

6.39 Single Platform Core and Uniface Edge Modification 6-44

6.40 Biface Functional Edges by Angle and Material Type 6-45

6.41a Biface Length Comparisons 6-45

6.41b Biface Edge Angle Comparisons 6-45

6.42 Core and Formal Tool Material Types 6-46

6.43 Flake to Core Ratios in Summed Assemblages for Periods and Phases 6-47

6.44 Complete and Nearly Complete Projectile Points 6-49

6.45 Material Type and Breakage Patterns of Projectile Points . . . 6-50

6.46 Groundstone Tool and Material Types 6-51

6.47 Groundstone Types by Completeness 6-52

6.48 Attributes of Complete and Nearly Complete Groundstone Artifacts 6-53

6.49a Mano Use-Wear Versus Material Type 6-55

6.49b Metate Use-Wear Versus Material Type 6-56

6.49c Groundstone Fragment Use-Wear Versus Material Type 6-57

6.50 Fire Alteration on Groundstone Material Types and Items Sorted by Completeness 6-58

6.51 Size Class Versus Fire-Alteration for all Generations 6-59

6.52 Degree of Use-Wear Versus Fire Alteration on Metates 6-61

6.53 Groundstone Material Types by Temporal Categories 6-63

6.54 Groundstone Tool Types by Temporal Categories 6-64

TABLES (continued)

TABLE Page

6.55 Groundstone Tool and Material Type Percentages in Temporal Groups 6-65

6.56 FAR Material Types by Temporal Period 6-66

7.1 Ceramic Coding System for Laboratory Analysis 7-2

7.2 Ceramic Type Frequencies for Collected Ceramics 7-4

7.3 Frequencies of Vessel Form by Ceramic Type for Rim Sherds . . 7-7

7.4 Rim Eversion by Vessel Form 7-8

7.5 Ceramic Types in Phase II Survey Units 7-11

7.6 Ceramic Type Frequencies by Survey Unit 7-12

7.7a Vessel Form and Type Frequencies of Body Sherds 7-14

7.7b Vessel Form and Type Frequencies for Rim Sherds 7-15

7.8 Rim Eversion and Rim Form for El Paso Brownware Type 7-17

8.1 General Characteristics of Spatial Associations of Artifacts and Features in Mesa Top Survey Units 8-4

8.2 Summary Statistics for Lithic Variables Calculated for Spatial Association in Area 1 and 2 Survey Units 8-4

8.3 Vector Loading for Lithic Variables in Area 1 and Survey Units 8-5

8.4 Distribution of Groundstone Fragments, Angular Debris, and Undifferentiated Flakes by Size 8-13

8.5 Mean Lithic Tool and Debris Counts for Clustered Spatial Association 8-20

8.6a Distribution of Associations in Period and Phase Categories by Cluster Grouping 8-21

8.6b Distribution of Recorded Surface Features in Period and Phase Categories by Grouping 8-21

8.7a FAR and Surficial Ash Stain Features in Clusters 8-22

8.7b Frequency of Excavated Features in Clusters 8-22

8.8 Fire-altered Rock Material Type Frequencies 8-22

TABLE OF CONTENTS (continued)

TABLES (continued)

TABLE Page

8.9 Material Types and Size Classes for Fire-altered Rock and Incomplete Groundstone in Clusters 8-23

8.10 Flake and Debris Use in Clusters 8-24

8.11 Ration of Bowl to Jar Sherds in Clusters 8-24

8.12 Assemblage Groups as Defined by Amount of Recycled Groundstone, Associated Features and Measures of Lithic Assemblage Variety and Distribution Density 8-27

8.13 Artifiact Size and Its Relationships to Artifact Frequency and Density with Increased Elevation 8-37

9.1 Radio Carbon Dates Obtained for Excavated Features 9-39

9.2 Obsidian Hydration Dates for Quadrant 45SE 9-41

9.3 Obsidian Hydration Measurement and Radiocarbon Date Comparisons for Obsidian Ridge Source Gravels 9-43

9.4 Burned Seeds, Charcoal, and Other Plant Parts from Floatation Samples 9-45

9.5 Artifact Class Frequencies by Unit and Excavation Feature . . . 9-48

9.6 Cross Tabulation of Excavated Features and Chipped Stone Type 9-50

9.7 Cross Tabulation of Excavated Features and Groundstone Types . 9-51

9.8 Frequencies of Ceramic Types by Unit and Excavation Feature . 9-52

9.9 Material and Chipped Stone Tool Types for Features Radiocarbon Dated Prior to 550 B.C. 9-53

9.10 Material and Chipped Stone Tool Types for Features Radiocarbon to A.D. 325 9-53

9.11 Material and Chipped Stone Tool Types for Features Radiocarbon Dated Subsequent to A.D. 1050 9-54

9.12 Flake Length and Stage Comparisons 9-55

9.13 Dimensions of Subsurface Deposits and Presence of FAR at Tested Features 9-56

TABLE OF CONTENTS (continued)

TABLES (concluded)

TABLE Page

9.14 Mean Lithic and Groundstone Frequencies of Eleven Assemblage Groups Obtained Through a Cluster Analysis of Feature Assemblages 9-59

9.15 Feature Assemblages by Period and Phase 9-60

9.16 Tested Feature Dimensions and FAR Frequencies at Clustered Features 9-62

9.17 Feature Assemblage Groups Organized by Assemblage Variety/ Density Relationships 9-65

9.18 Summary of Surface and Subsurface Artifact Assemblages by Artifact Size and Type for Select Features 9-69

9.19 Summary of Kolmogorov-Smirnov Tests Comparing Surface and Subsurface Assemblages for Select Features with Respect to Artifact Size and Artifact Type as Presented in Previous Tables 9-71

FIGURES

FIGURE

2.1 The Project Area in South-Central New Mexico 2-2

2.2 Landforms and Geomorphic Surfaces West of the Rio Grande in South Central New Mexico 2-3

2.3 Survey Area and Topography 2-4

2.4 Bolson Surface - Cover Zones and Subzones 2-6

4.1 Previous Archaeological Projects in the Land Exchange Area . . 4-2

4.2A Survey Area 1 4-5

4.2B Survey Area 2 4-6

4.2C Survey Area 3 4-7

4.3 Standardized Artifact Counts in Survey Units 4-10

4.4A Surficial Ceramic Artifact Densities in Survey Areas 4-12

4.4B Surficial Lithic Artifact Densities in Survey Areas 4-13

4.4C Surficial Groundstone Artifact Densities in Survey Areas . . . 4-14

TABLE OF CONTENTS (continued)

FIGURES

FIGURE **Page**

4.4D Surficial Hammerstone Densities in Survey Areas 4-15

4.4E Surficial Fire-Cracked Rock Densities in Survey Areas 4-16

4.5 Survey Area Topography 4-17

4.6 Level of Visibility Versus Discovery Rate for Artifact Categories 4-27

4.7 Land Status Map of the Navajo-Hopi Land Exchange Area 4-30

4.8 Artifact Distribution and Topography in Survey Unit 1, Survey Area 1 4-37

4.9 Artifact Distribution and Topography in Survey Unit 16, Survey Area 1 4-38

4.10 Artifact Distribution and Topography in Survey Unit 3, Survey Area 2 4-39

4.11 Artifact Distribution and Topography in Survey Unit 25, Survey Area 2 4-40

4.12 Artifact Distribution and Topography in Survey Unit 32, Survey Area 2 4-41

4.13 Artifact Distribution and Topography in Survey Unit 50, Survey Area 2 4-42

4.14 Artifact Distribution and Topography in Survey Unit 75, Survey Area 2 4-43

4.15 Artifact Distribution and Topography in Survey Unit 110, Survey Area 2 4-44

4.16 Artifact Distribution and Topography in Survey Units 2 and 3, Survey Area 3 4-45

4.17 Artifact Distribution and Topography in Survey Unit 21, Survey Area 3 4-46

4.18 Artifact Distribution and Topography in Survey Unit 45, Survey Area 3 4-47

4.19 Artifact Distribution and Topography in Survey Unit 48, Survey Area 3 4-48

TABLE OF CONTENTS (continued)

FIGURES (continued)

FIGURE | Page

4.20 Relationships Between Phase I and Phase II Artifact Counts . . 4-51

5.1 Percent Artifacts Discovered by Artifact Length for a) Ceramics b) Chipped Stone, c) Groundstone 5-7

5.2 Percent Artifact Discovered by Artifact Size Classes for a) Ceramics, b) Chipped Stone, c) Groundstone, and d) Fire-Altered Rock 5-8

5.3 Percent Artifacts Discovered by Artifact a) Length or b) Size Class Comparing Artifact Classes 5-9

5.4 Limit of Area Within Which most Points Relating the Percent Artifacts Discovered to Amount of Elapsed Sweep Time by Sweep Artifact Total 5-15

5.5 Relationship Between the Number of Red and Orange - Flagged Artifacts According to Sweep Artifact Total 5-18

5.6 Percent of Chipped Stone Discovered vs. Chipped Stone Length and Color for Individual Discovery Crew Members 5-26

5.7 Percent Artifacts Discovered vs. Date for Individual Discovery Crew Members 5-29

5.8 Percent Artifacts Discovered vs. Time of Day for Individual Discovery Crew Members 5-30

6.1 Relationship Between Proportions of Sandstone Groundstone and FAR in Summed Assemblages 6-35

6.2 Relationship Between Proportion of Volcanic Rock Groundstone and FAR in Summed Assemblages 6-35

6.3 Ranges of Variables Contributing to STAGE Index (a) Before and (b) After Stretching/Compressing 6-36

7.1 Histogram of Rim Diameters 7-10

8.1 Plot of SVD Dimensions 1 and 2 for Survey Unit 1 8-7

8.2 Plot of SVD Dimensions 1 and 2 for Survey Unit 25 8-7

8.3 Plot of SVD Dimensions 1 and 2 for Survey Unit 32 8-8

8.4 Plot of SVD Dimensions 1 and 2 for Survey Unit 50 8-8

8.5 Plot of SVD Dimensions 1 and 2 for Survey Unit 75 8-9

TABLE OF CONTENTS (continued)

FIGURES (continued)

FIGURE		Page
8.6	Plot of SVD Dimensions 1 and 2 for Survey Unit 110	8-9
8.7	Plot of SVD Dimensions 3 and 4 for Survey Unit 1	8-10
8.8	Plot of Unit 25, Dimensions 3 and 4	8-10
8.9	Plot of Unit 32, Dimensions 3 and 4	8-11
8.10	Plot of Unit 50, Dimensions 3 and 4	8-11
8.11	Plot of Unit 75, Dimensions 3 and 4	8-12
8.12	Plot of Unit 110 Dimensions 3 and 4	8-12
8.13	Artifact Distributions and Topography in Unit 45	8-31
8.14	Elevation Profile of Unit 45	8-32
8.15	Exposure Pattern for 300 Random Points in Unit 45	8-33
8.16	Exposure Pattern for Chipped Stone in Unit 45	8-33
8.17	Exposure Pattern for Chipped Stone in Unit 45	8-34
8.18	Exposure Pattern for Groundstone in Unit 45	8-34
8.19	Frequency of Chipped Stone, FAR, and Groundstone by 1M Intervals Over Elevation in Unit 45	8-35
9.1	Key for Excavation Maps	9-14
9.2	Feature 2 in Unit 45SE	9-15
9.3	Feature 3, 7 and 15 in Unit 45SE	9-16
9.4	Feature 8 in Unit 45SE	9-17
9.5	Feature 13 in Unit 45SE	9-18
9.6	Feature 3 in Unit 45SW	9-19
9.7	Feature 4 in Unit 45SW	9-20
9.8	Feature 17 in Unit 45SE	9-21
9.9	Feature 5 in Unit 45SE	9-22
9.10	Feature 1A in Unit 48SW	9-23

TABLE OF CONTENTS (continued)

FIGURES (concluded)

FIGURE Page

9.11 Feature 3A in Unit 48SW 9-24

9.12 Feature 4A in Unit 48SW 9-25

9.13 Feature 4B in Unit 48SW 9-26

9.14 Feature 4 in Unit 50 9-27

9.15 Feature 5 in Unit 75 9-28

9.16 Feature 4 in Unit 21SW 9-29

9.17 Feature 2 and 3 in Unit 48NW 9-30

9.18 Feature 6 in Unit 48NW 9-31

9.19 Feature 4 and 14 in Unit 45SE 9-32

9.20 Feature 5 in Unit 45SE 9-33

9.21 Feature 10 in Unit 45SE 9-34

9.22 Features 11 and 16 in Unit 45SE 9-35

9.23 Feature 12 in Unit 45SE 9-36

9.24 Feature 18 in Unit 45SE 9-37

9.25 Feature 4 in Unit 21SNE 9-38

9.26 Pollen Diagram for Excavated Features 9-46

PLATES

PLATE

6.1 Paleoindian and Archaic Projectile Points 6-69

6.2 Archaic and Early Formative Projectile Points 6-69

6.3 Unclassified Stemmed and Other Projectile Points 6-71

6.4 Formative Period Projectile Points 6-71

9.1 Feature 2D in Unit 45 Area 3, A Shallow, Saucer-shaped Pit Structure 9-4

9.2 View from the Northwest of Features 3 and 4 in Unit 48 9-8

TABLE OF CONTENTS (concluded)

PLATES (concluded)

PLATE Page

9.3 Structure Floor of Feature 3A in Unit 48, Area 3 9-8

9.4 Feature 4A in Unit 48 Area 3, Rectangular Pit Structure . . . 9-9

9.5 Feature 4 in Unit 50 Area 2, Circular Pit Structure 9-9

9.6 Feature 5 in Unit 75 Area 2, Excavated Half of Oval Pit Structure 9-10

CHAPTER 1

INTRODUCTION: DISTRIBUTIONAL SURVEY ON THE WEST MESA

Between September 15, 1984 and May 16, 1985, Bureau of Land Management (BLM) personnel participated in archaeological survey, in-field analysis, and excavation of features in the Navajo-Hopi Land Exchange Project (NHLEP) area in New Mexico. A total of 15,591 acres situated on the international border and along the western border of the Rio Grande Valley in the geographic area known as the Mesilla Bolson was investigated. Project lands are distributed in three separate parcels in southeastern Dona Ana County. Survey Area 1 lies on the western edge of the Rio Grande Valley in portions of Section 12 in T. 28 S., R. 2 E. and portions of Sections 7, 18, and 19 in T. 28 S., R. 3 E. totaling 3,852 acres. Survey Area 2 is situated on the valley border as well and includes 2,475 acres in portions of Sections 33 and 34 in T. 28 S., R. 3 E. and Sections 3, 4, 9, 10, 11, 14, 15 and 16 in T. 29 S., R. 3 E. Survey Area 3 takes in 9,264 acres of the desert basin floor in Sections 3, 4, 9, 10, 14, and 15 in T. 29 S, R. 2 E. and Sections 21, 22, 27, 28, 33, 34, 35 and portions of Sections 23 and 26 in T. 28 S., R. 2 E.

The purpose of the project was twofold. First, the narrow timeframe slated for archaeological inventory and subsequent intensive fieldwork and the knowledge that some project lands would contain areas with high densities of archaeological remains necessitated a survey to identify locations where data recovery requirements leading to mitigation of potential adverse effects on cultural resources in the exchange area could not be adequately met within the project timeframe. A Phase I survey was instituted for this purpose and concentrated on gathering artifact and feature density data through systematically walked transects in a grid network encompassing the entire study area. Analysis of the Phase I density data has indicated that highest densities of archaeological materials are located in Survey Areas 1 and 2 and are related to higher archaeological visibility and hence discoverability of remains as well as to probable long-term residential occupation of areas bordering the Rio Grande Valley. Based on these findings, 972.98 acres distributed in Survey Areas 1 and 2 were set aside for application of land patent restrictions so that the cultural resources on this public land might be conserved and protected for future archaeological investigation.

The second project goal included intensive surface documentation of a sample of project lands and excavation of subsurface remains encountered within this sample. Accordingly, the remaining project lands were sampled with a Phase II distributional survey by which 1,107 acres (448 hectares) were walked with a 5-meter transect spacing. All discovered artifacts in Phase II survey units were flagged and analyzed with an in-field coding format. Locational coordinates of all artifacts and features were then recorded using an electronic distance meter (EDM), resulting in the documentation of large piece-plotted surfaces. A total of 40,350 lithic and ceramic artifacts and pieces of fire-altered rock (FAR) and 155 surficial features were inventoried in this fashion from 5 800 x 800 meter and 8 400 x 400 meter survey units.

Discovered features include accumulations of FAR lacking any associated subsurface deposits and those associated with buried pits and structures. The subsurface extent of 88 features initially manifested as surficial ash-stained deposits was defined through a Phase II feature testing program and 28 features were subsequently excavated. While feature preservation in this area is variable, well-preserved pits and pit structures ranging in age from about 2500 B.C. to A.D. 1050 demonstrate a long and continuous use of desert basins in south-central New Mexico for residential and other functions.

Distributional survey techniques such as those used during Phase II are becoming increasingly used in cultural resource management (Ingbar et. al 1983;Seaman - 1987; Wandsnider and Larralde 1984). Computerization has enabled efficient management of large data bases documented with distributional techniques, and field methods are becoming increasingly streamlined and tailored to fit regional requirements. Recent local projects have also initiated computerized in-field artifact coding (Hard, personal communication concerning the Boulder Canyon Survey, Ft. Bliss, Texas) which will do away with the cumbersome scribing of attributes, data input, verification, and error checking stages, some of the most tedious and time-consuming aspects of the data recovery procedures of a distributional survey. Table 1.1 compares the NMLEP distributional survey effort with that of another recent distributional survey, the Seedskadee Cultural Resources Assessment Project (Wandsnider and Larralde 1984).

DISTRIBUTIONAL SURVEY ON THE WEST MESA

This report uses the distributional data gained through the Phase II survey to examine strategies of prehistoric land use on the West Mesa, the portion of the Mesilla Bolson bordering the Rio Grande Valley in the vicinity of El Paso, Texas. Distributional data differ from conventional site data in that the episodic use of places where artifacts are clustered at "sites" is not automatically assumed. Since the sites of past behavior are not viewed as directly reconstructable, this report differs in several ways from one in which conventional survey data would be summarized and evaluated.

Most archaeological reports look at a new area in old ways. Even though a new area is being studied each time, the archaeological reports reach similar and sometimes interchangeable conclusions. They conclude that a series of different cultures inhabited an area through time, beginning with early big game hunters and progressing through more generalist, dry-period "Archaic" peoples until agricultural adaptations were adopted in the area. Although names and the purported times of these "cultures'" dominance may vary slightly, and sometimes not all stages are present, such a three-stage scenario typifies archaeological reports from all parts of the United States. Again almost invariably, its tenets include ever-increasing population through time; quick shifts between subsistence strategies occasioned by environmental changes or the influxes of new ideas or populations followed by long periods of adherence to relatively uniform lifeways; evolutionary shifts in technology through the inclusion of new elements such as atlatls, the bow and arrow, and ceramics; and, particularly, the assumption that the archaeological record more or less directly reflects the separation of these distinct cultures in separate locations or sites, or stratified layers of such sites.

Typically, the three-stage scenario is broken down into substages, each taken as representing geographically or temporally circumscribed differences in technological responses to subtle environmental variation or cultural boundaries. Upon inspection, such substages can be seen to have "evolved," that is to have increased in complexity, through time beginning with an original, regional "founding archaeologist" and proliferating as his or her students or competitors "refined" the original tripartite cultural-historical scheme.

Such uniform culture-historical conclusions are based, not surprisingly, on a very consistent kind of archaeology, one that dominates regional summaries and cultural resource management thinking in the United States. This archaeology begins with a survey methodology that is based on a variable, "multistage" inspection of areas at radically differing but relatively low intensity for evidence of archaeological "sites," which by definition are bounded areas of high concentrations of artifacts and features, surrounded by other areas containing little or no archaeological evidence. The supposed existence of site boundaries is based on sometimes implicit, and sometimes explicit--but in fact never operationalizable or at least never operationalized--(see Chapter 3) density or area criteria. Sites so "defined" are classed into single or a small number of "cultural" categories on the basis of "diagnostic" artifacts. Archaeological materials which occur between these "sites" are ignored either because they are "undiagnostic," because they are not concentrated and are thus "isolated occurrences," or probably most often because they are not believed in and thus are not sought and found.

When these "sites" have been defined, only the largest and most "unique" are deemed significant and thus worth of study, preservation, or other mitigative measures. The goal of this kind of archaeology--most cultural resource management archaeology--is to find very small areas within the landscape which are claimed to contain "significant" archaeological materials, separated by very large areas which contain no significant archaeological materials and thus do not have to be dealt with by archaeologists. This is seen as

TABLE 1.1. Compilation and comparison of effort for completing distributional survey tasks.

Task	Seedskadee Archaeological Project *	Navajo-Hopi Archaeological Project
Control Installation	1.0 500-m2 units/pday	1.0 400-m2 units/pday
	3 persons/day	2 persons/day; EDM;
	3 units/day)	2 units/day)
	26 units	28 units
	26.0 pdays	28.0 pdays
Discovery	25 500-m2 units	28 400-m2 units
	625 ha	448 ha
	135 pdays	140 pdays
	4.62ha/pday	3.20 ha/pday
Artifact Attribute Encoding (in-field)	16,000 artifacts	40,350 artifacts
	120 pdays	280 pdays
	133.3 artifacts/pday	144.1 artifacts/pday
Mapping EDM and scribing coordinates	6,100 entries	30,800 entries
	70 pdays	275 pdays
	87.1/pday	112.0/pday
	218/mean crew day	448/ crew day
Input and Verification	17,500 entries	71,150 entries
	25 pdays	90 pdays
	700/pday	790.6/pday
Error Checking	25 pdays	40 pdays
	17,500 entries	71,150 entries
	700/pday	1778.75/pday

NOTES: *Seedskadee Project Data and Table compiled by LuAnn Wandsnider.
pday - refers to person days and m2 should be read as meters on a side.

fulfilling the "mandate" of government responsibility in a cost-effective way.

This volume is different. The initial premise upon which the work it reports on was based is that no automatic, prefieldwork assumptions can be made about the distributions of archaeological materials across the landscape, or about the meanings or significance of those distributions. Before boundaries of sites can be determined, the distributions of the physical evidence upon which they are to be based must first be empirically (that is, physically) determined through the intensive search for archaeological objects (artifacts and features). It is simply astonishing what a difference such a lack of assumptions makes in the archaeological materials that are, in fact, discovered and recorded. When the object of an archaeological survey is to find all surface archaeological items, rather than to find "sites," the outcome is not that sites are more "accurately" or "completely" found. The outcome is an inescapable conclusion that those "sites" do not exist as boundable entities in the surface archaeological record at all. Archaeological materials are found in a variable but continuous distribution everywhere across the landscape. A consideration of the figures illustrating mapped distributions of artifacts and features in Phase II survey units (see Chapter 4) will bear out this conclusion.

The survey methodology used in the NHLEP is not really a new idea. It has been a sub-current in archaeological science for at least 15 years, beginning with the "nonsite" or "off-site" concepts of Thomas (1975), Isaac and Harris (1975), and Foley (1980, 1981a, 1981b, 1981c). These archaeologists, for a variety of different reasons, realized that the materials described as falling within "sites" were not the only meaningful portion of the archaeological record, and that those artifacts and features which did not seem to be parts of traditionally-defined "sites" might also have some significance in the determination of past patterns of the overlay of human organizational systems over the landscape. Not only were the sites meaningful--the "nonsite" materials between them were as well.

The reasons that these archaeological pioneers felt this way were largely based on their experience with looking at the archaeological record in areas where the existence of those objects lying between "sites" was obvious and inescapable--arid regions where vegetation did not restrict the discovery of such materials.

More recently, the exploration of the meaning of "nonsite" archaeological material has been pursued from a more theoretical direction (Camilli 1983; Ebert, Larralde, and Wandsnider 1983, 1984; Ebert 1986). "Theoretical," in this light, is not to be taken in some sort of impractical or academic sense, but rather from the standpoint of the process of evaluating our scientific assumptions concerning the formation processes of the archaeological record. The key factor in such thinking is the extremely long time period over which the archaeological record has been formed--tens of thousands of years, at least, in North America and far longer in other areas. Archaeologists are assumed to be steeped in the essence of time, but in reality many of them have never considered the implications of human systems having used the Earth's landscape for these immensely long periods. Over such periods of time, many thousands of generations of hunter-gatherers and agricultural peoples have continuously repositioned their places of habitation and other uses again and again over the surface of the Earth. Given this repetitive use of landscapes, it is almost inconceivable that all usable places have not been used more than once, and most many times--even perhaps tens or hundreds of times. When approached in this way, the archaeological record in almost all places is expectably the sum of the overlapped discard resulting from many episodes of human activity, many separated by long periods of time.

What is more, in most places (other than fortuitous locations where the deposition of natural sediments takes place at roughly the same tempo as do episodes of human use of the landscape, probably a very rare occurrence), it is likely that many of these overlapped events result in archaeological deposits that cannot be automatically--or easily--separated in stratigraphic terms. The resultant archaeological record is not the result of separable episodes of past human activity, as commonly assumed by the "traditional" archaeology. Instead, the archaeological record is the result of the repetitive repositioning of portions of human organizational systems over very long time periods across the landscape.

The methods employed in the NHLEP survey, and its subsequent interpretations and conclusions, are not those that would be expected on the basis of any traditional archaeological investigation, or on the basis of traditional archaeological thought. They are revolutionary in ways that might not be immediately appreciated. In the remainder of this introduction, the ways in which the the project has contributed to a rethinking of archaeological methodology will be outlined, as well as the ways in which its findings impel one to reach counterintuitive conclusions regarding the prehistory of the NHLEP study area and, in fact, some of the ways that they change the tenor of archaeology in general and cultural resources management archaeology in specific.

First, and most obviously, when one makes no assumptions about archaeological materials being clustered in small "pieces" within the landscape, but rather looks for it everywhere with comparable search intensity, archaeological materials are everywhere. The first reaction that most archaeologists have to the idea of maps being made which show the location of all artifact occurrences across the landscape is an expectation that they will be able to draw site boundaries more easily. This is not the case. As one can see by looking at the distribution maps presented later in this report, boundaries cannot be readily drawn. Archaeological materials--artifacts and features--are distributed evenly, albeit often at low and uneven densities, everywhere. When one can see their total distribution, it is not a straightforward task to draw artificial boundaries around artifact clusters. The archaeological record is a continuous, albeit variable, distribution across the surface.

For this reason, it is unnecessary to discover where archaeological materials are present and where they are not since they can be shown to occur as continuous distributions of varying densities. What is more, the vast majority of the materials discovered during the course of the NHLEP are "undiagnostic." Clusters of artifacts and features, such as they are, can for the most part not be assigned on the basis of artifact form to cultural periods. Is this because they do not have time depth, because they were not deposited over long time periods? The answer, as likely as not, is no. It is because most of the materials expectably discarded in the course of the operation of human systems is not "diagnostic," but is rather for the most part mundane--the result of the maintenance of tools rather than their ultimate discard and the use of other utilitarian items.

The predominance of such "undiagnostic" materials in the archaeological record stems from a major characteristic of cultural adaptations, one incorporating the planning and staged manufacture of technological components. It is that all human technological systems are based on anticipation, transport, and maintenance of technological components, and hence only a small proportion of discarded or lost materials can be expected to be whole or identifiable tools. In fact, as later portions of this report will amplify, one of the major aspects of the portion of the record due to human modification is due to the reuse or recycling of lithic and other materials to the extent that they are for the most part "undiagnostic."

In the same way that artifacts across the landscape are ubiquitous--that is, continuously distributed--so are features, those unmovable portions of the archaeological record. More than anything else this finding reinforces the conclusion that all portions of the landscape that were usable were used. In the NHLEP survey, about 95 features (pit structures and hearths) were found per square mile in those areas assumed to be of low occupational density. This also bespeaks continuous occupation and very likely overlap of occupations in the past.

Archaeology is the study of human, or cultural, organizational systems. The key word here is systems. Cultural adaptations are systemically organized, and are unique in nature. Animals respond and organize themselves totally in response to the contingencies of the environment, and thus their activities can be predicted on the basis of resource availability alone. Human or cultural organizational systems are different in that they involve anticipation or planning, the fundamentals of which are basically different from those of biological organization. Human organizational systems involve the symbolic anticipation of--or planning for--conditions that are distant in time and space. For this reason, the places and times that people do things are dependent on the other places and times where and when people do things. Very simply, what this means is that in order to determine, predict or model where past activities took place requires the knowledge of where other activities were undertaken at other places, and at other times. To model and understand cultural systems of organization requires that the discarded products of systems be looked at in as continuous an area as possible, since it is not only the locations and occurrences of items that are adjacent in space that is important for accomplishing this task. The relationships between items that are not adjacent in time and space must also be considered. It should be apparent then that constructing analytical linkages between archaeological phenomena requires knowledge of the spacing, occurrence, and coincidence of items that are not adjacent but distant as well, data which must be gained through examining the archaeological record over large pieces of landscape.

The methodological strategy upon which the NHLEP survey is based is a minimum requirement for beginning to understand this kind of interrelationship between all of the materials available from the archaeological record. Without knowing just what data are important, data cannot be missed or overlooked, knowingly or unknowingly. The archaeological directions that are made available by the methods used in this survey are indispensable for advancing the state of archaeological knowledge since all parts of the overlapping, continuous archaeological record are assumed important and are documented.

REPORT SUMMARY

The analytical utility of a distributional data base for understanding the past use of landscapes is explored through a number of studies in the following chapters.

Chapter 2 provides a description of the local environment and addresses issues concerning the archaeological integrity of cultural remains in sand dune environments. Chapter 3 discusses the archaeology of the project area. Interpretations of south-central New Mexico prehistory are reviewed and the ethnographic evidence for different land use strategies presented. The results of the Phase I and Phase II surveys are summarized in Chapter 4 and an in-depth analysis of the Phase I density data presented. The utility of the distributional data base for investigating biases inherent in the processes of discovering and analyzing archaeological materials are addressed in Chapter 5. Analyses of lithic and ceramic data documented by the Phase II survey follow in Chapters 6 and 7. Chapter 8 compares the content and structure of artifact and feature distributions and examines the differential distribution of artifacts with respect to topography. Description of excavated features in Chapter 9 is followed by an analysis of the surficial artifacts associated with all features discovered during the Phase II survey. Chapter 10 reviews and summarizes analytical findings.

CHAPTER 2
NATURAL LANDSCAPE AND ENVIRONMENT: DESCRIPTION AND INTERPRETATION

REGIONAL PHYSIOGRAPHY

The study area is situated within the Mesilla Bolson in south-central New Mexico. One of several intermontane basins in the Mexican Highland Section of the Basin and Range province, the Mesilla Bolson is bordered on the east by the Organ and Franklin Mountains and on the west by the Sierra de Las Uvas and the Potrillo Mountains (Figure 2.1). The only through drainage is the Rio Grande whose course occupies a north-south trough of the major graben system within the region that is responsible for the alternating river valleys and canyons of southern New Mexico.

Within the bolson, the Rio Grande floodplain widens between the Sierra de Juarez on the south and the Robledo Mountains on the north to form the Mesilla Valley, a fertile bottomland approximately 60 miles long and from 2 to 6 miles wide cut into poorly consolidated sediments of Cenozoic age. At its southern end is El Paso Canyon, a gorge cut by the Rio Grande through an updomed mass of Tertiary intrusive rocks and Cretaceous sedimentary rocks at the head of El Paso Valley.

Prior to entrenchment of the Rio Grande drainage system, the Mesilla Bolson was one of a number of broad internally drained structural basins which dominated the landscape of south-central New Mexico (Hawley 1965). The broad La Mesa plain lying south of Las Cruces and west of El Paso is the major preserved remnant of this ancient bolson floor. West of the Rio Grande, the relict bolson floor forms a level plain, the La Mesa Surface (Ruhe 1964), overlying lacustrine and riverine deposits of the Camp Rice Formation of the Santa Fe Group.

The La Mesa Surface is an areally widespread unit of sandy loam and loam sediment (Ruhe 1967:29) which grades downward into rounded gravels of mixed composition. Gravels range from more than 60 to less than 5 feet in thickness and overlie sands, silts, clays and conglomeritic sediments of the Santa Fe Group (Kottlowski 1953, 1958). Mid-Pleistocene vertebrate fauna have been recovered from sediments on the La Mesa Surface near Las Cruces (Ruhe 1962) dating formation of the plain to prior to 400,000 years ago (vertebrate fauna indicate beds are no older than late Kansan according to Ruhe 1967:29). Two member surfaces, the Upper and Lower La Mesa Surfaces, have been offset by the east Robledo fault zone (Seager and others 1981) and are separated by a scarp representing the southwestern extension of this fault zone (Figure 2.2) (Gile and others 1981:112). Soil differences between the upper and lower surfaces are attributed to an age difference--soil development on the lower surface occurring in later mid-Pleistocene time (Gile and others 1981:124). After development of the La Mesa Surface, cyclic entrenchment of the Rio Grande began (Hawley 1965:197).

The ancestral Rio Grande is thought to have initially meandered across the structural troughs of southern New Mexico finding its way southward by overflowing from one basin to the next (Hunt 1974:524). From the La Mesa plain, it probably flowed south-southwestward to evaporate in the many interconnected playas of northwestern Chihuahua southwest of El Paso. Crossbedding of the La Mesa gravels indicate stream flow to the southwest, as the ancestral Rio Grande must have meandered slowly across the southward sloping La Mesa plain, at times coming close to the hills of the Cerro de Muleros (Kottlowski 1958:48). The La Mesa Surface was then an unbroken plain stretching from the western slopes of the Franklin Mountains to the west and southwest.

Incision of the Rio Grande below the ancient basin floor began in the late mid-Pleistocene (Hawley 1965; Kottlowski 1958; Ruhe 1962, 1964; Strain 1959). Arroyos draining the Franklins, the northern part of the Juarez Mountains, and the hills of Cerro de Muleros drained eastward to the western end of the Hueco Bolson, and eventually a wide southeastward meander of the Rio Grande was captured by one such arroyo (Kottlowski 1958). The 18 foot per mile grade from the Cerro de Muleros to the lowest part of the Hueco Bolson east of El Paso insured downcutting near El Paso. Aggradation in the Mesilla and El Paso Valleys during interglacial stages alternated with the downcutting of valley floodplains by the river during glacial periods, resulting in

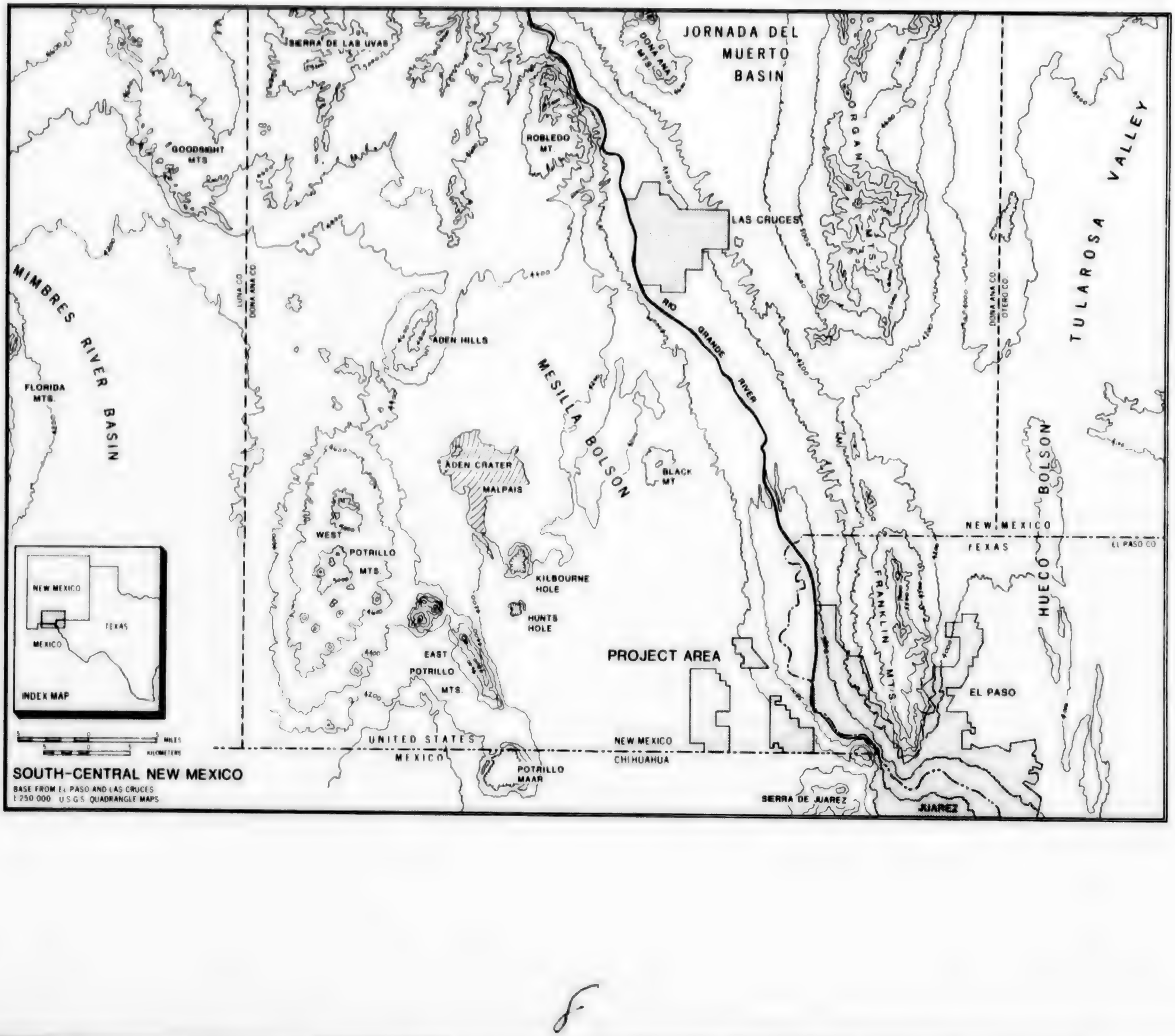


FIGURE 2.1.

THE PROJECT AREA IN SOUTH-CENTRAL NEW MEXICO.

terrace remnants. Three major geomorphic surface units related to temporary halts in the entrenchment of the Rio Grande are apparent near Socorro (Hawley 1965:190-191), while in the El Paso area Kottlowski (1958) recognizes four valley border surfaces below the La Mesa plain. Several terraces can be traced up the east side of Rio Grande in north El Paso Canyon. No distinct terraces have been identified in the lower Mesilla Valley on the west side of the Rio Grande.

At the international border, the Lower La Mesa surface extends as a broad plain to about 25 miles west of the Rio Grande Valley rim scarp. Here, at the southern end of the Mesilla Valley, this surface terminates in a jagged escarpment of exposed sedimentary deposits 300 feet above the western edge of the Rio Grande floodplain, its easternmost extension terminating on the international border. Viewing the La Mesa Surface in this area from the floodplain itself, one is given the initial impression of a level expanse of tableland. Survey Areas 1 and 2 are situated on the valley rim scarp and cover valley slopes and upland basin surfaces adjacent to the scarp. Survey Area 3 is located 2 miles from the rim scarp, at its nearest point, and includes only upland basin surfaces. The southeastern corner of the study area is situated about 4 miles immediately west of the pass between the Franklin Mountains and Sierra de Cristo Rey.

SURVEY AREA LANDFORMS AND VEGETATION

Of the 15,591 acres surveyed, a majority are distributed over the relict bolson surface stretching from the Rio Grande Valley rim scarp to as much as 10 miles to the west (Figure 2.3). A lesser amount of acreage, 2,475 acres, was

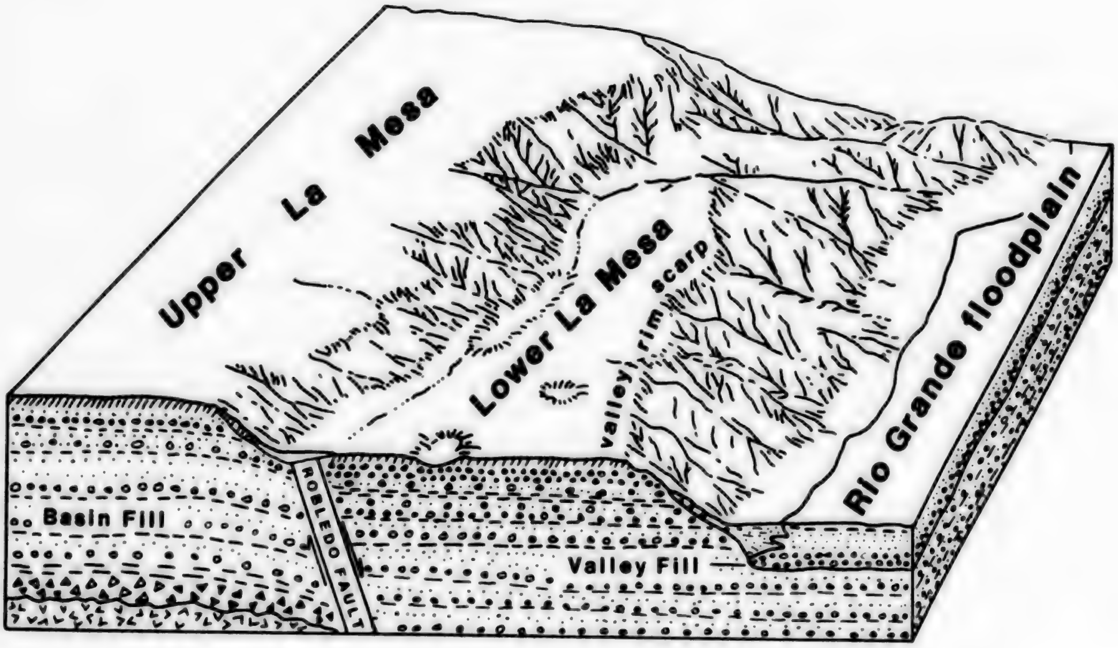


FIGURE 2.2.

LANDFORMS AND GEOMORPHIC SURFACES WEST OF THE RIO GRANDE IN SOUTH-CENTRAL NEW MEXICO (AFTER GILE, HAWLEY AND GROSSMAN. 1981: FIGURE 31)

BLANK

PAGE

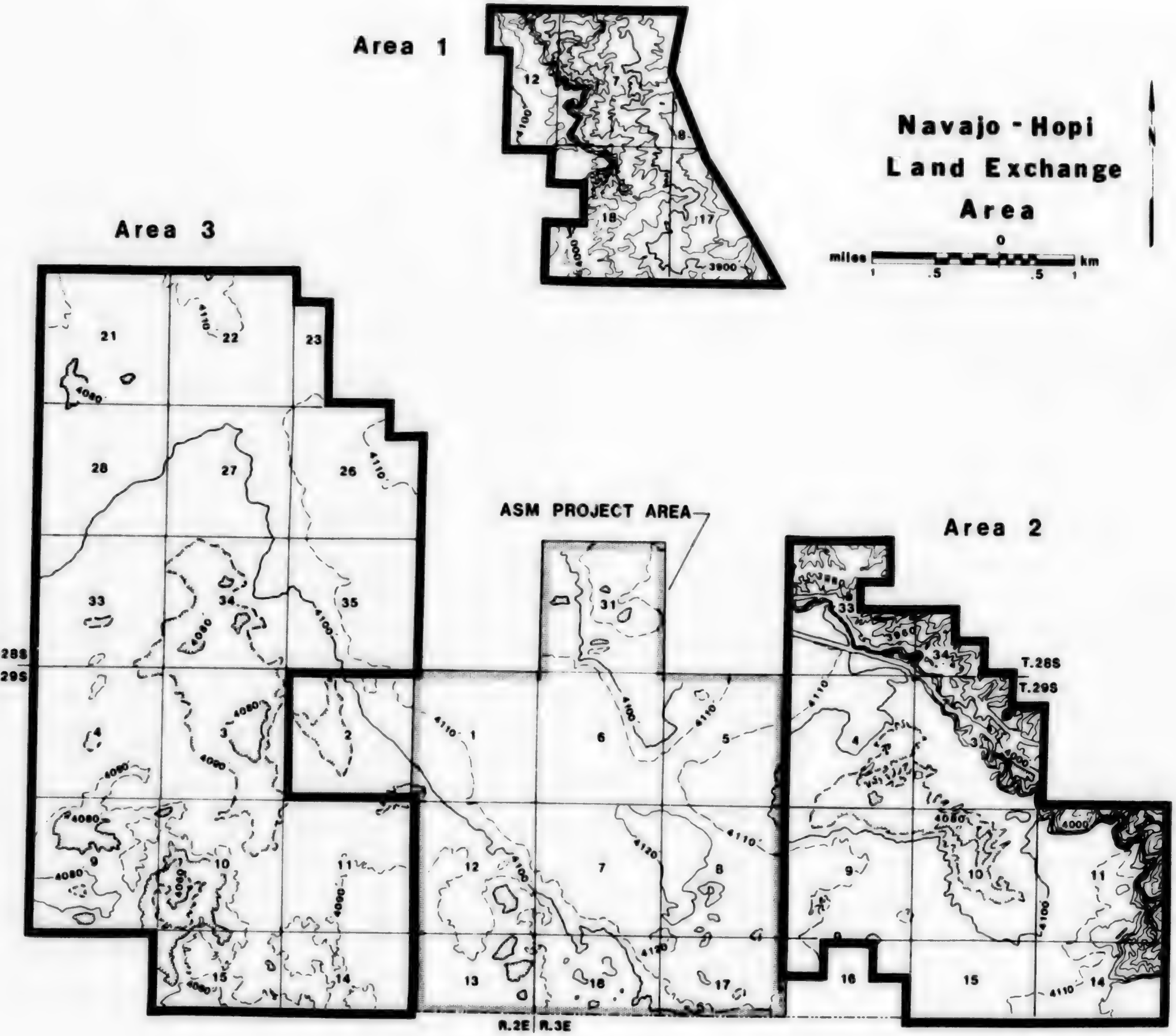


FIGURE 2.3.
SURVEY AREA AND TOPOGRAPHY.

surveyed on the valley slopes and ridges directly below and east of the valley rim scarp. Most of this latter acreage is located well over a mile from the western edge of the river floodplain. Elevations, averaging 3,740 feet at the Rio Grande, rise to 4,080 feet along the scarp.

Although local relief on the internally drained upland La Mesa Surface is low, 10 to 20 foot elevational differences on "scarp" or "ridge" features on the upland may afford enough relief to significantly affect the visibility of archaeological materials, rendering them more readily discoverable along such features. Relief here is related primarily to two parallel rises which run southeast to northwest from the southwestern corner of Survey Area 2 to the northern portion of Survey Area 3 (Figure 2.3) and have been interpreted by Davis et al. (1985) as a possible fault-line feature:

> A scarp about 15 to 35 feet (5 to 11m) high runs northwest-southeast through Sections 31, 6, 5 and 8 and faces northeast. Another scarp about 20 feet (6 m) high lies parallel to the first but about a mile (1.6 km) to the southwest and faces southwest. The scarps may be fault-line scarps of Pleistocene age, and a dune covered highland lying between the scarps may be a horst.

This "highland" terminates at the base of a 10 foot high "ridge" on the northern edge of Area 3. Bordering the "scarp" faces on the east are complexes of deflation basins of possible Pleistocene age similar to the "cusp-shaped embayments of lower surfaces and deposits" on the La Mesa margin described by Ruhe (1967:29) for areas farther north. Davis and others (1985) interpret closed depressions west of the "scarp" as ancient deflation hollows and piping features.

The upland bolson surface and adjacent valley slopes have been described by O'Laughlin (1980) as the West Mesa and Leeward Slope environmental zones. The Leeward Slope in portions of Survey Areas 1 and 2 contains slopes dominated by aeolian sands and shallow, gravelly soils on terrace remnants, ridge tops, and alluvial fans (O'Laughlin 1980:19) bordering the western edge of the Rio Grande floodplain. The West Mesa is the level upland plain of the La Mesa Surface whose soils form coppice dunes anchored by mesquite. Interdunal areas are surfaced by sparse lag gravels and are generally barren of vegetation. Portions of Survey Areas 1 and 2 and all of Area 3 are contained within this zone.

Nials (Appendix A), using 1:40,000 scale black and white aerial photographs, has photointerpreted three divisions of the West Mesa zone (Figure 2.4) based on patterns in surface geomorphology and vegetation. These are a Mesquite Coppice Zone and a Yucca Dunes Zone which taken together include the majority of the study area and an Inactive Sand Sheet Zone represented primarily in areas bordering localized depressions. While the relevance of photointerpreted conclusions to the archaeological integrity of these zones will be evaluated later in this chapter, their identifying characteristics serve as a detailed description of topographic variability on that portion of the West Mesa surface included in the study area. The following descriptions have been condensed from Appendix A.

The Mesquite Coppice Zone includes four subzones:

1. Zone 1a. Interdunal Pleistocene-floored blowouts include non-coppice areas floored by Pleistocene sediments. Some large gravels are almost always present on blowout floors with indurated caliche locally present in the vicinity of major depressions. Modern sand cover in these areas is between about 25 and 60 percent with local relief from 2 to 5 meters.

2. Zone 1b. Areas of partial sand sheet are represented by low relief mesquite-anchored coppice accumulations and some areas between coppice dune covered by a sand sheet approximately 0.5-1.0 meters in thickness. The sand sheet is believed to be of relatively modern age.

3. Zone 1c. Relict large-scale deflation basins are 0.5 kilometers or larger in maximum dimension with deepest portion up to 10 meters lower than surrounding areas.

4. Zone 1d. Escarpment edge coppice dunes with relatively thin sand accumulations covering highly calcareous sediments are present on the West Mesa scarp.

BLANK

PAGE

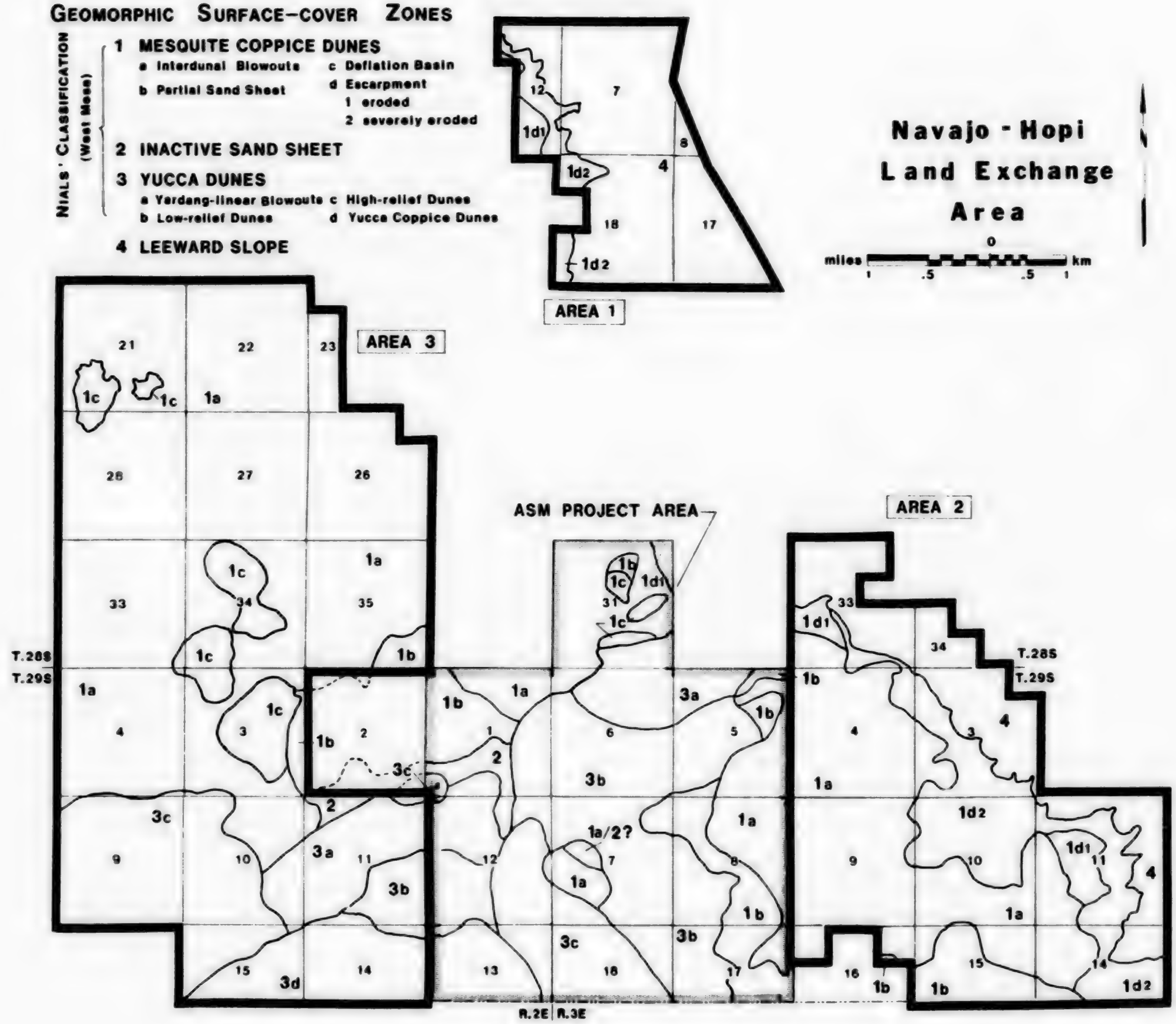


FIGURE 2.4. BOLSON SURFACE-COVER ZONES AND SUBZONES.

12

The Inactive Sand Sheet Zone is present only in the Area 3:

1. Zone 2. Characteristics include a smooth sheet of recently deposited aeolian sand, with an almost total absence of blowouts, coppice accumulations, and other dune forms of mesquite. Relief here is estimated at less than 30 centimeters in most locations.

The Yucca Dunes Zone also includes four subzones:

1. Zone 3a. The Yardang-linear blowout subzone is composed of yardangs, elongate blowouts, small parabolic dunes with a substrate of aeolian sand.

2. Zone 3b. The low-relief dunes zone includes small parabolic dune accumulations and roughly circular blowouts. Modern sand cover is estimated at approximately 90 percent with present local relief placed between 2 and 3 meters.

3. Zone 3c. A high-relief dunes zone is made up of small parabolic dunes overlying relict deflation basins. The deflation basins are 10-15 meters lower than surrounding terrain and local relief is placed between 2 and 3 meters except in areas of the deeper deflation having relief of 10-15 meters.

4. Zone 3d. A yucca coppice dune subzone consists of yucca-anchored coppice accumulations superimposed on a sand sheet of unknown age. Local relief is estimated at 1-2 meters.

Vegetation in the Mesquite Coppice Dune Zone includes mesquite (Prosopis glandulosa) as the primary anchor for coppice accumulations. Some accumulations also occur with saltbush (Atriplex canascens) and yucca (Yucca elata). The percentage of ground cover and variety of species in this community is less than that of the Yucca Dunes Zones (Moore and Bailey 1980). Other plants include snakeweed (Gutierrezia sarothrae), zinnea (Zinnea pumila), and globemallow (Sphaeralcea subhastata). Deflation basins are commonly dominated by stands of indigo (Dalea sp.). Mormon tea (Ephedra trifurca) and chamisa blanca (Chrysothamnus pulchellus) are also relatively abundant.

The Yucca Dunes Zone is dominated by coppice accumulations around soap-tree yucca (Yucca elata). Common shrubs include four-wing saltbush (Atriplex canascens), Mormon tea (Ephedra trifurca), mesquite (Prosopis glandulosa) and snakeweed (Gutierrezia sarothrae). Sagebrush (Artemisia filifolia), zinnea (Zinnea pumila), globemallow (Sphaeralcea coccinea and S. subhastata), hogpotato (Hoffmanseggia densiflora), senna (Cassia bauhinoides), and sacaton grass (Sporobolus wrightii) are common. Goatshead (Tribulus terrestris) and unicorn plant (Proboscidea parviflora) also frequently occur, while grama grass (Bouteloua sp.), sunflower (Helianthus sp.), and prickly pear cactus (Opuntia sp.) are present in small quantities.

Creosotebush shrubland occurs on the West Mesa in the eastern portion of Area 1 and in the Leeward Slope Zone in both Areas 1 and 2. Creosotebush (Larrea tridentata) stands predominate in these areas and occur along with mescat acacia (Acacia constricta), ocotillo (Fouquieria splendens), winterfat (Eurotia lanata), and fluffgrass (Tridens pulchella) (Rodney and Sabo 1980).

PALEOCLIMATE

Climatic reconstructions for the late Pleistocene and following periods are based on geologic, palynological, faunal, and macrofloral evidence from southern Arizona and New Mexico and from west Texas. Correspondences between past climate and the archaeological remains within a region are commonly relied upon to reconstruct past subsistence-settlement patterns. What is not at all clear, though, is the extent to which natural depositional and post-depositional processes may selectively preserve different parts or components of a cultural system under different climatic conditions. If the archaeological record is structured at an interface of natural depositional and behavioral processes and both are in turn dictated by general climatic regimes as well as local conditions, then interpreting potential behaviors on the basis of reconstructed paleoclimates is not a straightforward task. The following is intended, therefore, as a review of general climatic trends within the regions, but is not meant as basis for reconstructing specific systems.

The interpreted Holocene sequence includes three major shifts in climatic regime and vegetation. With the onset of the Holocene at about 11,000 B.P., replacement of Late Wisconsin dense mesic forests with juniper/oak woodlands and grasslands

13

occurred. Until 8000 B.P., early Holocene environments were dominated by a pattern of winter precipitation (Van Devender 1977). From 8000 B.P., until 4000 B.P., paleoclimate reconstructions for the middle Holocene stress the presence of desert grassland and the appearance of desert shrub species after 5000 B.P., (Van Devender and others 1983). While patterns of widespread erosion were initially interpreted as evidence for warmer, drier conditions during the middle Holocene, Antevs' (1955) Altithermal, other interpretations (Martin 1963; Mehringer and others 1967; Van Devender and Worthington 1977:104) attribute Southwestern middle Holocene climates with a pattern of summer monsoonal rainfall presenting palynological, herpetofaunal, and macrofloral evidence for relatively wet conditions coupled with a period of warm weather. Precipitation is seen as decreasing after 4000 B.P. with late Holocene sequences punctuated by erosional periods and periods of increased precipitation. A desert shrub/grassland is believed to have characterized the entire late Holocene (Van Devender and Wiseman 1977).

Throughout the sequence outlined above, there is relatively small time-scale variation in climatic and vegetation that is difficult to detect and interpret. Van Devender and others (1983:354) suggest that boundaries between vegetational periods during the middle and late Holocene may not be distinct noting that some woodland species overlap into the middle Holocene while Chihuahuan Desert plants can occur as early as 5430 B.P. In addition, the numerous relatively minor changes recorded for the Late Holocene are probably due more to the sensitivity of fossil pollen, macrofloral, and other records for detecting these fluctuations in later periods than to absence of similar minor climatic changes during earlier periods.

As previously indicated, the Altithermal portion of Antevs' post-glacial sequence as applied to Southwestern climates has been called into question. A number of researchers (see Carmichael 1983) have argued that since the mechanisms which cause erosion may not be directly related to a general climatic regime but to local conditions, evidence of warmer, drier conditions is not necessarily equivalent with the periods of erosion used by Antevs (1955) to reconstruct the Altithermal. Interpretations of pollen, packrat (Neotama) midden, and herpetofaunal records from southern New Mexico and west Texas offer alternative reconstructions detailed below.

Bryant (1977:16) finds evidence of widespread erosion in the Amistad region of west Texas slightly prior to 4000 B.P. The fossil pollen record from above and below the erosional contact in alluvial sediments is interpreted as representing similar regional vegetation in the Amistad region though pine and grass pollen are slightly reduced in the post-erosional record. In contrast to a widespread warm, dry period, local variation in summer temperature, as well as increased precipitation are posited as partial explanations for alluvial erosion prior to 4000 B.P. Johnson (1963:229) presents additional evidence for relatively moist conditions prior to 4000 B.P. in the Amistad region recognizing a corresponding period of erosion.

Bryant's findings correspond with a drop in mesic species and rise in xeric species of fossil lizards from Howell's Ridge Cave after 3,330 B.P. (Van Devender and Worthington 1977:99). Wet conditions are suggested until about 4,000 to 5,000 years ago based on an inferred permanent water supply in a nearby playa necessary for reproduction of salamander species present in the Howell's ridge stratigraphic column.

In arguing for the presence of an Altithermal in the Southwest, increase in grass pollen sometime after 4000 B.P. is presented by Freeman (1972) as evidence for a dry Altithermal in southern New Mexico. This interpretation is questioned by Carmichael (182:35) who suggests that the full Altithermal record is not represented in Freeman's sequence.

Pollen records for the following 3000 years indicate a general trend towards increased aridity punctuated by several increases in effective moisture. Evidence for periods of increased moisture during the late Holocene comes from a number of studies. Bryant (1977:17) interprets a brief mesic interval around 2500 B.P. characterized by rises in pine pollen and slight decreases in herbaceous pollen. The climate at this time is thought to have been slightly cooler and accompanied by widespread savanna conditions for a brief period (Bryant and Larson 1968; Bryant 1977:18). Hafsten

(1961:59-91) records a marked increase in pine pollen for his subzone A2, sediments marking the beginning of which have been radiocarbon dated at 2850+100.

Correspondence of several other pollen records with Bryant's findings reinforce an interpretation of a brief widespread mesic period at about 2500 B.P. Pollen records from deposits at the Lehner site and the Murray Springs locality (Martin 1963; Mehringer and Haynes 1965) demonstrate a peak of increasing effective moisture between 2400 and 1400 B.P. Low cheno-am pollen and high grass pollen counts at about 2200 B.P. in Freeman's profile from Site D at Gardner Spring may correspond to this mesic period, although sediments at his Site C are interpreted as indicating a dry trend at this time.

Mesic conditions at about 1,100 years ago are suggested by another increase in grass pollen in the Gardner Spring record and corresponds to increased summer precipitation for the Southwest at about 1,000 years ago as noted by Martin (1963).

HISTORICAL CHANGES IN VEGETATION

Two issues appear central to discussion of recent historical changes in vegetation in this portion of the Southwest: (1) whether vegetation change in the last 100 years, namely replacement of grassland with desert shrubland communities, was initiated by recent climatic cycles or through overgrazing by domestic stock, and (2) the extent to which grasslands in south-central New Mexico have actually been replaced by desert shrub communities.

With respect to the first issue, Carmichael (1983:45) briefly summarizes the climatic evidence in the form of global warming trend documented by Denton and Porter (1970:110) coupled with increased aridity in the last 100 years for arguments espousing climate change as the primary determinant for disappearance of grasslands. In support of an overgrazing model, York and Dick-Peddie (1969) present evidence for differences in modern vegetation when compared with vegetation documented by land survey records from the late 1800's. These authors cite the presence of grasslands in some areas for the last 100 years as indicating slight if any climatic change during this period. Pockets of mesquite associated with prehistoric "campsites" are identified as the sources of desert shrub communities which expanded in response to reduction in grass cover attributed to the effects of cattle.

Since both overgrazing and climate change are documented for the region, a model of vegetation change which takes both into account may be appropriate for some areas. Noting that the region is marginal for desert grassland, Carmichael (1983:45) claims that regional vegetation patterns would be highly susceptible to change due to climatic fluctuations of the magnitude documented by Denton and Porter (1970:110).

The second issue is more directly pertinent to interpretation of prehistoric adaptations within the region. As previously mentioned, the initial occurrence of desert shrub species has been placed at around 4000-5000 B.P. (Van Devender and Spaulding 1979). Based on macrofloral evidence, it would seem that the desert shrub communities dominated by mesquite and creosotebush have been present on mesas and bolson floors within the region for the last 4,000 years, and if so, that an overgrazing model of vegetation change may not strictly apply to many areas within the region. In addition, General Land Office records used to support the overgrazing model have provided questionable vegetation reconstructions (Eidenbach and Wimberly 1980:11-13; Carmichael 1983:45), leading to a conclusion that present day vegetation has occurred throughout the region for a considerable period of time. Countering claims for replacement of grasslands by desert shrub communities during the late 1800's, Eidenbach and Wimberly (1980:11-12) cite the coincidence of periods of unusually high rainfall and early civil surveys as responsible for lush grass cover recorded in some areas. This coincidence is additional evidence for the rapid fluctuation in the composition of local vegetation in response to brief climatic change.

Records of past vegetation in the El Paso area include accounts of Spanish chroniclers and several early land surveys (Bartlett 1854; Emory 1848). Traveling from the vicinity of Chihuahua City to El Paso in July of 1766, Nicolas de Lafora describes the climate and vegetation in the region south of El Paso (Kinnaird 1966:82):

> As soon as we crossed the little Bordo pass we entered some very troublesome sand dunes two leagues long with several slopes. These are formed wither from the sands of the Rio Del Norte [Rio Grande] by the furious winds in these parts or superimposed upon a small chain of hills already there... we came to a very sandy slope. Then we descended to a plain covered with mesquite, huizaches, etc.

Immediately south of El Paso, de Lafora further describes the terrain:

> On the 19th we traveled five leagues north over rolling hills with several small ravines and gorges along the road and much mesquite but little pasture. We arrived at the presidio of Nuestra Senora del Pilar Paso del Rio del Norte.

Almost a hundred years later, the mesquite coppice dune terrain along the international border in the southern portion of the study area was again documented during survey of the international border following the Gadsen Purchase. In his 1858 notes, accompanying sketches of terrain along the 31° 47' parallel, John E. Weyss states of Sketch No. 3 looking westward from the West Mesa scarp at the international boundary (Executive Document No. 41):

> The line here leads over an apparently endless level table-land, which is very sandy and generally without grass, but thickly covered with clumps of bushes and small sand-hills four or five feet high.

In the immediate study area at least, the above observations lead to a conclusion that whether climate change or overgrazing determined the presence of desert shrub communities, is not a central issue. Rather, it is altogether possible that mesquite and creosotebush communities were prevasive prior to 100 years ago and that desert grasslands may have been cyclically present in some areas due to local short-term climate change.

Although further study and more systematic documentation of recent vegetation change is beyond the scope of this study, the above review supports interpretations of past behavior which take present environmental conditions into account. Mobile and sedentary adaptations which rely on the diversity, predictability, and distribution of resources within the region modeled by recent researchers rely to great extent on present climatic conditions and will be reviewed in Chapter 4.

SURFACE DYNAMICS OF THE STUDY AREA AND THEIR ARCHAEOLOGICAL SIGNIFICANCE

All archaeological materials are affected by the natural dynamics of the sediments of which they are a part, or upon which they rest. When artifacts and other culturally used or modified materials are discarded, lost or abandoned, they rest on the surface of the ground for a period of time. In some cases they are incorporated into sediments relatively quickly, by one or more natural or cultural processes, and in other situations they remain on the surface for long periods and occasionally (particularly in arid lands) are never incorporated within sediments. Archaeological materials that are incorporated in sediments can be uncovered again, and re-covered, in a cyclical way, with varying degrees of spatial movement and other disturbance (Foley 1981). In order to be discovered, recorded, and interpreted by archaeologists, in fact, artifact and features must be uncovered in one way or another--in rare instances through excavation, but far more often by natural processes. It is tempting to implicitly or explicitly assume that it is only those artifacts which are encapsulated in sediments, a condition sometimes referred to as their being "stratified" (Davis and Nials 1985:10), that are worthwhile to the archaeologist. This is an unrealistic stance for many reasons, some of which will be explored in depth later in this section. In the simplest sort of way, it is an unproductive argument since archaeologists hardly ever see materials that are incorporated in sediments because these are hidden. More realistically, since except in an incredibly narrow set of circumstances (for instance, in caves or on certain river floodplains with regular and gentle alluviation) all archaeological remains have once been "surface" materials, and many have always been. Virtually none are "in situ," in any sort of reconstructive sense.

Searching for and assuming that certain archaeological materials are the direct reflections of specific episodes of past human behavior, and can be translated directly into reconstructed scenes from the past, has recently been likened to looking for "little Pompeiis" (Binford 1981:195), with uneaten food still on the table and the body-casts of guests in the courtyard. Unfortunately (or perhaps fortunately!), the archaeological record is almost never like Pompeii. Natural processes always intervene in the long hiatus between deposition and archaeological recovery. All archaeological materials are, to some extent, "disturbed." Taking the stance that disturbed archaeological materials are not useful, or cannot yield information, to the archaeologist suggests, then, that there may well be no justification for archaeologists or archaeology at all. The theme of this section is that this is not the case, that natural disturbances of archaeological materials do not render them worthless or indecipherable. A corollary of this is that it is not possible, using a geomorphological "disturbance" argument, to decide that the archaeology of certain portions of a study area can be ignored. Determinations of the usefulness of all parts of the archaeological record-- that is, of its significance in research terms--can only be made on the basis of arguments based in archaeological theory. Naive assumptions about what is "important" or "useful" to archaeologists are as out of place in contemporary cultural resource management as are methods which ignore natural, depositional, and post-depositional processes.

In order to assess the impact of natural depositional and post-depositional disturbances of archaeological materials on archaeological interpretation, two things must be considered: (1) the nature and dynamics of those post-depositional processes in a study area, and (2) the types and scales of archaeological disturbance that can be tolerated in research terms. The latter will be the subject of discussions later in this report; this section concerns the nature of the specific post-depositional processes operative in the Navajo-Hopi Land Exchange Project (NHLEP) area.

Davis and Nials' Interpretation

In 1984, as part of the Arizona State Museum's (ASM's) preliminary survey of 5,600 acres in the NHLEP area, a ground and photointerpretive analysis of the geomorphology of the study area was undertaken (Davis and Nials 1985) as an adjunct to archaeological fieldwork. The focus of this interpretation was to determine in which parts of the area archaeological remains would be visible and in which they would be stratified (Davis and Niles 1985:10).

> To a large degree, the aspects of visibility and stratification are mutually exclusive; remains which are visible on the surface of the ground are usually out of stratigraphic context, and those remains in stratigraphic context are usually buried and therefore invisible...

Stereo photointerpretation of 1:40,000 scale black-and-white aerial photographs taken in May 1982 resulted in the definition of three strata or zones: (1) the Mesquite Coppice Zone, (2) an Inactive Sand Sheet Zone, and (3) a Yucca Dunes Zone. These have been described at greater length previously in this section. Zones 1 and 3 were then broken down into subzones, which will be remarked on later. Archaeological implications were then summarized for each of these zones.

Davis and Nials' (1985) stratification of the ASM survey area was extended to cover the contiguous NHLEP area. This was accomplished through photointerpretation (a subsequent ground check was not requested), and the zones they defined as well as their characterizations are identical (Appendix A). Briefly, Davis and Nials' Mesquite Coppice Zone is characterized by coppice dunes anchored by Prosopis, lying on a deflated surface armored by pebbles. The deflated surface forms interdunal flats between the coppices. Between the coppice dunes, "archaeological visibility is good... [and] because all of the specimens have been deflated (or never were buried) and lie exposed as particles in the lag gravel, spatial context for these specimens may be moderately well preserved, however, stratigraphic context for such specimens is nearly nil" (Davis and Nials 1985:11). Zone 2 consists of a nearly uniform sand sheet, in which visibility of archaeological materials is "...essentially nil" (op. cit. 1985:11). In Zone 3, an area of parabolic dunes dominated by yucca, visibility is again poor, but in some portions of Zone 3 there is higher visibility and the potential for better preservation of context than in Zone 1.

17

A Reinterpretation

For the purposes of this section, the stratification scheme advanced by Davis and Nials has been re-investigated, using the same aerial photographs used in their study. These were photointerpreted using a Topcon scanning mirror stereoscope with 1.8x and 3x magnification. The criteria upon which this later photointerpretation were based will be discussed at length later. Now, however, two basic criticisms of Davis and Nials' initial interpretation will be outlined.

Scales of Interpretation

The first of these major criticisms is that the scale of the original interpretation--particularly the subdivision of the three basic strata into substrata--may be either grossly undergeneralized, grossly overgeneralized, or both. Any exercise in the interpretation and mapping of "natural" differences across the landscape must be approached through the consideration of the scales, or physical sizes, of phenomena which one is interested in observing relative to those natural differences. In this case, the scale of archaeological patterning must first be considered. There are a number of levels at which the scales of archaeological patterning might be approached. One of these is that of human systemic organization--the scale of the repetitive positioning of human activities across the landscape during the course of an "annual round," or perhaps more appropriately, given the resolution provided by archaeology materials, many hundreds of annual rounds of similar adaptive systems.

Given this perspective, the ASM study area is extremely small, about 9 square miles. The original ASM study area stratification was later expanded to cover the BLM's inhouse NHLEP area of some 25 square miles, using the same zones and subzones (see Appendix A). While the reinterpretation resulted in no substantial argument concerning the boundaries of Davis and Nials' Zones 1 and 3, Zone 2, at least within the NHLEP area, is extremely small in extent (about 1 x 0.2 miles) and seems to be the result of downwind sediment dispersal from a single blowout area. At systems organizational scale, Zone 2 should be discounted. It should also be noted that while the ASM's study area was largely Zone 3, the NHLEP area consists of approximately 85 percent Zone 1. At a systemic level, the Davis and Nials' stratification is too detailed, and it is more appropriate to consider the entire study area as representative of a single "zone" in terms of its geomorphological dynamics.

Another magnitude of scale at which archaeological patterning must be considered is that of the general size of characteristic episodic human activities, for instance the size of settlements, or of activity areas within settlements. At this level of scale, issue is taken with Davis and Nials' overgeneralization--lack of detail--of Zones 1 and 3 on a subzone level. In order to differentiate the effects of natural processes on archaeological patterning resulting from episodic human activities, the stratification would have to be carried out on an extremely small-scale basis, with the extent of zones on the order of perhaps 5-50 square meters, far less generalized than Davis and Nials' large, continuous subzones. Such a level would produce maps with differentiations as detailed as that of interdunal versus dunal surfaces --which would require almost unimaginably intensive on-the-ground survey, or photointerpretation from extremely large scale (1:1,500 or even larger-scale) aerial photographs.

For this reason, the reinterpretation of the zones reported on here did not entail differentiation of subzones. Instead, it concentrated on the consideration of the surface and immediately subsurface dynamics of Zones 1 and 3, the conclusions of which are described below.

Archaeological Significance of the Davis and Nials' Interpretation

A second substantive criticism of Davis and Nials' interpretations concerns the meaning of the geomorphic differences between Zones 1 and 3 in terms of the archaeological record there, and in cultural resources terms -- that is, the amount of effort or consideration that should be spent in carrying out archaeological discovery and analyzing the materials found there. Basically, Davis and Nials' conclusions are that archaeological materials in all of their areas will either be visible but unstratified (and thus not worth analyzing), or stratified but invisible (and thus not worth looking for). Given the above-quoted paradigm with which these researchers approach the archaeological record, then, archaeology is in a perpetual double-bind. It will be suggested here that the integrity and value of cultural resources must be determined not through recourse to such a priori precepts, but rather with reference to research questions posed by archaeologists themselves.

The Surface and Subsurface Dynamics of the Study Area

Geographically, the survey area as previously discussed lies directly to the west of the Rio Grande, on the sandy loam and loamy sediments of the La Mesa Surface (Ruhe 1967), underlain by the gravelly, erosion-resistant strata of the Camp Rice Formation; the erosionally resistant nature of the Camp Rice Formation has impeded the development of significant drainages except, of course, that of the Rio Grande itself (Gile, Hawley and Grossman 1981). The Camp Rice Formation was originally the floor of the Mesilla Bolson, a large internally-drained basin, and is of late Pleistocene age (Hawley 1965). Pedologically, the soils of the study area include the Wink-Pintura Complex, the Wink-Harrisburg Association, the Pajarito-Pintura Complex, and Simona-Harrisburg Association, and the Bluepoint-Caliza-Yturbide Complex--a taxonomically complicated group with common characteristics of high water permeability and thus slight fluvial erosion hazard, and surface sand and sandy loam layers between 2 inches and 60 inches thick below which an indurated caliche layer occurs (Bulloch and Neher 1980).

Atop the Pleistocene basin floor lies a mantle of aeolian sand, deposited according to almost all authors since the late 1800's, (Gile, Hawley, and Grossman 1981), or perhaps even as recently as 80 years ago (Kenmotsu and Pigott 1977). The conclusion to be reached from these gross geomorphic interpretations is that until relatively recently--between mid-Pleistocene and historic times, in fact--all of the archaeological materials that would have resulted from human activity in the study area would have been dropped on a coarse, gravelly, water-permeable and erosion-resistant surface, and would have remained where they were dropped. The nature of artifact movement and disturbance on the La Mesa Surface prior to its covering by the recent sand sheet may have been quite minimal. Some of the sediments making up part of the sand mantle covering the more windward portions of the study area, in fact, may be derived from more leeward areas; internal pedogenesis in the coppice portions of the "Rotura Soil" (Gile 1966), near Las Cruces and analogous to portions of the Mesquite Coppice Zone, suggest that some of these sediments may have been in place longer than 100 years.

Davis and Nials (1985), following York and Dick-Peddie (1969), hold that the present vegetation of the study area--mesquite, yucca, and associated desert scrub--appeared at the same time as did the sand sheet, due either to the pressures of grazing (York and Dick-Peddie 1969) or short-term climatic change (Denton and Porter 1970). As noted, however, others have questioned reconstructions of past vegetation based on General Land Office reports during the late 1800's (Eidenbach and Wimberly 1980), postulating instead that a change from grassland to desert shrub in the area, which can be supported on the basis of macrofloral and faunal data (Van Devender and Worthington 1977; Van Devender and Spaulding 1979), has probably seen a large number of short oscillations within the last 4,000-5,000 years (Carmichael 1982).

Again thinking about scales of observation, this time temporal rather than spatial, both positions are probably correct. Fluctuations like the one evidenced by increasing aeolian erosion and the invasion of mesquite and other desert scrub over the last 100 years have probably occurred throughout most of the Holocene in the study area. If this is the case, then the archaeological materials there have all been subjected to a number of episodes of covering and uncovering. In order to assess the differences in the mechanics of this oscillation between Davis and Nials' Zones 1 and 3, the area was photointerpreted with this problem in mind.

Re-Photointerpretation

In October 1985, the black-and-white 1:40,000 scale aerial photographs which had previously been used by Davis and Nials were reinterpreted stereoscopically. The focus of this photointerpretation was to attempt to determine the nature of surface processes operating within the area in a systemic sense. In other words, rather than concentrating on the ways that the

19

strata were different, the interpretive emphasis was on identifying similar processes to aid in the comparison of the zones. Using Davis and Nials' stratification map as a guide, each stratum was intensively inspected for indicators of dominant surface processes.

Within the actual study area itself, vegetation in Zone 3 was seen to obscure the underlying landforms there, particularly along its eastern boundary with Zone 1, which appears simply as a subtle but abrupt change from a darker tone, representing relatively continuous vegetation, to a lighter, less continuous mesquite coppice area. South of the international boundary, however, grazing has obviously been far more intensive than on the United States side, reducing the vegetation cover in Zone 3 so that its tone is indistinguishable to slightly lighter than that of Zone 1. This renders the underlying, topographic landforms of Zone 3 far more interpretable, and it becomes apparent that this zone is composed of a series of parabolic dunes overlain one upon the other. In the more western portions of Zone 3, the dunes have been overlain to the extent that individual dunes are difficult to distinguish, and the overall impression is of a continuous sand mantle. The eastern boundary of Zone 3, where it meets Zone 1, is comprised of very distinct parabolic dunes with darker interdunal flats, against the background of which the noses of the dunes can be seen to point toward the northeast to east-northeast. This indicates their formation by a prevailing wind direction of southwest to west-southwest.

Interpretation of the two valid zones (1 and 3) in terms of their complementary dynamics can be summarized by classifying Zone 1, the Mesquite Coppice Zone, as an erosional or deflational zone, while Zone 3 is a depositional or accretional zone. Photointerpretation, particularly of those portions of these zones appearing south of the international border, reveals that the parabolic dunes comprising Zone 3 are derived from the transport of sediments by southwesterly winds which occur during the spring when soil moisture is low and thus sand mobility is highest. The sediments which actually make up the dunes of Zone 3 may be derived from bolsons to the southwest. Zone 3 is, then, an accretional zone where transported sediments are building a more or less continuous sand sheet, probably with little sediment removal at least at the present time.

Zone 1, on the other hand, consists of relatively small accumulations in coppices, separated by larger and cleaner interdunal areas and thus is the site of two complementary processes--accumulation and removal. Within Zone 1, sediments may be deposited uniformly, but are removed primarily from interdunal areas and accreted against mesquite to form coppice dunes; thus, both dunes and interdunal areas are relatively stable and retain their identities. Zone 3 is more uniformly characterized by the deposition of sediments, both as parabolic dunes and on interdunal areas, with sediments deflated from interdunal areas replaced by additional sediments transported from outside the study area.

Reinterpretation of Archaeological Relevance

Archaeological materials in both Zones 1 and 3, then, derive primarily from the underlying Pleistocene surface, and have all been subjected to relatively little water erosion and varying amounts of aeolian erosion since their deposition. In Zone 1, archaeological materials are exposed along with lag gravels--in place of original La Mesa Surface materials--between coppice dunes. Beneath the coppice dunes, archaeological materials also lie where deposited, but are not presently visible during surface survey. Archaeological materials in the interdunal flats are, of course, not "stratified," but have been deflated (or remain) in a single horizontal layer which contains the accumulated archaeological record. While the horizontal relationships between artifacts in these areas are preserved, their vertical layering is not.

Archaeological materials are incorporated into deposited sediments by periods of natural activity--for instance, in the study area and much of the Southwest, blowing winds in the spring. Such events are separated by periods of relative inactivity--the lack of blowing sediments in the late summer through winter seasons. Periods of natural activity of sufficient energy to cover many kinds of artifacts may be separated not by seasons, but by years or decades. All of the archaeological materials that are discarded by an ongoing cultural system between periods of natural depositional activity are encapsulated in the same sediment stratum, which may contain a year's or a decade's worth of discarded materials.

Cultural systems are composed of a series of functionally differentiated activity loci--that is, "sites" which are used for different purposes through the course of an annual round. In most cultural systems, at least some and often almost all places can be expected to be re-used for such different purposes during the course of a year. The archaeological record contained in a "single stratum," then, will be of a composite, overlapping nature even if there is relatively constant deposition and sediment layering. The archaeological record in all places--buried or on the surface--will to some degree lack vertical differentiation necessary to separate episodes of activity or occupation at any place.

The degree of lateral movement of these artifacts that has taken place since their loss or discard is surely much less than the size of interdunal flats, and may be far less--Davis and Nials (1985:23) suggest that pebbles from blowout bottoms may have moved as much as "...several meters horizontally." The analytical consequences of this amount of artifact movement, and in fact the final determination of whether such movement has occurred, must be determined in conjunction with archaeological spatial analysis of these materials. In general archaeological terms, the horizontal integrity of the materials discovered during the course of archaeological survey of the interdunal flats in Zone 1 may be as high as that of archaeological materials in most situations.

The conclusions concerning the integrity and visibility of archaeological materials in Zone 3 reached in this reinterpretation are essentially the same as those forwarded by Davis and Nials (1985)--their integrity may be high, but they can be of low visibility, with much higher visibility in localized settings within the parabolic dunes. Even small amounts of materials so visible may prove to be reliable indicators of shallow archaeological deposits, however, a conclusion borne out by the NHLEP survey and discussed later in this report. For reasons discussed immediately above, the degree of integrity or distortion of buried, stratified materials should be quite similar to that of the archaeology exposed in interdunal flats (or buried beneath coppices) in Zone 1.

21

CHAPTER 3

EXPLANATORY DIRECTIONS IN EL PASO ARCHAEOLOGY: A SHORT HISTORY AND EVALUATION

This chapter deals with the archaeology and ethnology of the project area. What is meant by archaeology in this report is the things that archaeologists have said about prehistory in and about the Navajo-Hopi Land Exchange Project (NHLEP) area that is relevant to the studies reported on here; ethnology should be taken in the same sense. This chapter will be a synthesis of the formulations made by archaeologists and anthropologists in their attempts at understanding and explaining the archaeological record as it is found in and around the project area. It will also attempt to relate these archaeological statements to relevant ethnographic accounts, which may provide some alternative ways to explain observations of the archaeological record in south-central New Mexico.

The narrative account of archaeological and ethnographic ideas given in this chapter are all the more interesting in that they can be seen as representative, in many ways, of the derivation of ideas about cultural history and evolution in many if not most parts of this country. Deciding what happened in the past in their study area is something that confronts all archaeologists everywhere. The "sociology" of archaeological thought is rarely explicitly discussed in the literature, however. This chapter will try to use an "historical" approach to structure an examination of the derivation of the things that archaeologists have said about the archaeology relevant to the study area.

Not surprisingly, the history of archaeological thought in almost all areas is somewhat the same. Archaeology in most "culture areas" across this country was initiated in the early 1930's and 1940's and was based on the precepts of that time. More surprisingly, though archaeology has been billed as changing (according to some accounts, radically) between then and now, our basic scenarios have in fact remained the same. Archaeologists' accounting of the sequences of change in what people did through time, which are generally thought of as their "culture history," remain essentially similar even though archaeologists profess to be devoted to different paradigms (different bases for scientific explanation) over the years.

It will be argued later in this chapter that the reason for this continuity is that archaeology has not changed methodologically to any substantial degree since its beginnings. It is still based for the most part on the unquestioning use of field procedures which guarantee that archaeologists will search for, discover, measure, and perceive the archaeological record in certain ways. When the archaeological record is looked at in alternative ways -- through the application of new methods -- very different interpretations of it might be made. The survey of the NHLEP area in New Mexico described in this report is, in fact, representative of a very new methodological approach which allows such alternative explanations of the archaeological record.

In order to illustrate this, the present synthesis will trace the sequence of scientific thought concerning the interpretations of the archaeological record in the El Paso area -- southern New Mexico and southwestern Texas -- using the archaeological literature as a basis. Different explanatory directions used in interpreting the cultural sequence there will be analyzed and discussed not only from a "theoretical" standpoint, but also with respect to the methodologies which shape the ways archaeologists see their data. Following the explication of approaches to the archaeological record in this study area, the ethnographic record relevant to the area will be briefly discussed and contrasted to what archaeologists have said about possible human adaptations there.

THE CULTURE HISTORY OF THE STUDY AREA: A MICROCOSM OF AMERICAN ARCHAEOLOGY

It is interesting that the general "culture history" of all places in the United States is virtually the same, according to the archaeologists working there. Prehistory is almost always divided into three broad, long-lasting phases seen to be more or less internally coherent and to be distinctly bounded from one another.

The first stage is the Paleoindian stage, generally attributed to about 10,000 B.P.+ to 7000-5000 B.P., peopled by specialized large-game hunters who exhibited extremely high mobility and focused on the specialized hunting of extinct large gregarious mammals (Lehmer 1948; Marshall 1973; Beckes 1977; Whalen 1980; Carmichael 1983). That these groups had large range sizes is usually substantiated by reference to the fact that their lithic tools are made from high-quality materials from sources distant from the place in which they are found. Artifacts diagnostic of Paleoindian assemblages are usually projectile points which are sometimes found in association with extinct herbivore remains but more often in places that are intuitively "ideal" for specialized hunting practices -- around closed basin playas, on ridges where one would have an ideal "overlook," or near springs. Rarely are sites with large numbers of herd animal remains found, but Paleoindian sites in other places are diagnosed on the basis of the occurrence of projectile points similar to those found in sites with extensive faunal remains.

Following the Paleoindian period, presumably between 7000 and 5000 B.P. when climatic conditions became drier (see Chapter 2), a Paleoindian way of life was no longer practicable and people adopted an "Archaic" lifestyle consisting of more generalized plant gathering, with some dependence on medium- to small-sized animal species. There is some disagreement as to whether this shift was occasioned by the very efficient depletion of larger game species by the Paleoindians. The Archaic peoples were presumably somewhat less mobile than Paleoindians, depended on a wide spectrum of plant species, and moved about in small groups consisting of nuclear families or multiples thereof, opportunistically gathering the fruiting parts of those plants that were available at any specific time. These are the people that there is the most abundant ethnographic record of, particularly in the Great Basin where ethnographers between about 1915 and 1930 recorded the annual rounds of the Paiute, Ute, Shoshone, Pai, and other documented groups.

Archaic technology includes some new elements such as evidence of atlatls, but is nowhere as distinctive, in the sense of being as neatly divisible using diagnostic artifacts, as technology was during Paleoindian times. Archaic people are usually cited as using more local lithic materials far more expediently than the Paleoindians, and as using a far wider inventory tools made of relatively perishable wood, bone, and other organic materials. Where conditions for preservation are favorable, primarily in rockshelters and caves, many organic items are found.

Regardless of the generalized technology by which they made their living under conditions usually portrayed as being hot, dry, and unfavorable, the Archaic peoples' population is in almost all places seen as slowly growing through the 5,000 to 7,000 years that this lifestyle persisted. Although almost always acknowledging that caution must be used in making such interpretations, archaeologists studying the Archaic usually base their perceptions of expanding Archaic populations on greater numbers of later sites or radiocarbon dates. As population packing becomes greater, horticultural practices are postulated in some places.

Suddenly, beginning about the time of Christ -- in some places several hundred years earlier or later -- and again in almost all parts of this country, new lifestyles are documented by archaeologists. These later prehistoric people adopted agriculture, and the "formative" period began. While the formative period is far more obvious or developed in the eastern and midwestern United States than in some portions of the west, it will be seen that it figures highly in the culture history of the El Paso region study area as well. Beginning in this period, there are a number of striking developments in the material inventory noticeable in the archaeological record. The most obvious of these is the appearance of domesticated crops -- maize, beans, squash, amaranth, and other horticultural or agricultural occurrences. Bows and arrows indicated by smaller and more formalized projectile points replace atlatls or spears. Ceramics appear in general use during this period, and styles of decoration and form proliferate. It is often assumed, as shall be discussed in this chapter, that local ceramic decoration styles and vessel forms develop for use in different functional or social situations. The existence of economic and other sorts of interaction are ubiquitously postulated, and often called upon for the explanation of different regional variants of culture during the Formative Period.

Formative period technology usually shows evidence of not only utilitarian items, but also clearly nonutilitarian objects as well — ornaments, highly decorated ceramics, ceremonial items cached in niches, and imported bells, shells, and parrots. The archaeological interpretation of these items is that they are indicative of the rise of a specialized class of administrative or religious elite, who used these objects to solidify their power over the lower classes who provided these leaders' subsistence.

Formative period people live in large, elaborate and presumably permanently-occupied villages, some of which become enormous, and have distinct regional political divisions which are mirrored in the stylistic elements of their material culture.

In all places, the Formative period cultures collapse after European incursion and become mobile, less elaborate, or totally disintegrate.

Here, the more specific forms in which this general cultural scenario has been adapted by archaeologists to explain the culture history of the NHLEP area and surrounding areas will be traced. This will be approached in a rough historical sequence -- not the history of past peoples, but the history of archaeologists -- by tracing the development of explanations and perceptions of the archaeological record.

It will be seen that while archaeologists through time in this study area are in relative agreement about the nature of their data -- that is, for the most part believe they are working with the "same data base" -- they have used different sorts of explanations to account for the nature of these data.

There are four general explanatory pathways that have been followed in accounting for the archaeological record in the study area. Below, a taxonomy of these explanatory avenues is set forth. Each will then be explored briefly.

A TAXONOMY OF EL PASO REGION CULTURAL HISTORIES

In the El Paso region, as in most "culture" areas in the United States, perceived developments in the archaeological record are documented in a similar way through time and then explained in different ways. That is, the cultural "sequence" is adhered to by successive investigators through time, but the reasons for cultural change are explained in different ways. There are four basically different ways that archaeologists approach the explanation of the culture history of the El Paso area. These are:

1. Explanations based on a postulation of cultural relationships and exchanges, or interactions between cultural groups of different identities, typified by Lehmer (1948), Marshall (1973), and more lately Ravesloot (1985a, 1985b).

2. Explanations predicated on the occurrence of cultural evolution, couched in general environmental terms but primarily postulating evolutionary stages through which people in the area passed (Beckes 1977; Skelton et al. 1981; Whalen 1977, 1978, 1980, 1985; Whalen and LeBlanc 1980; Carmichael 1981, 1983a, 1983b, 1984, 1985a, 1985b).

3. Explanations based on the reconstruction of environment, past climatic characteristics and changes, the differential occurrence of subsistence and other resources people could have used, and the actual resources they apparently did use as found in archaeological sites (O'Laughlin 1980, 1981; Hard 1983a, 1983b).

4. Archaeological reconstructions and formulations based on a different sort of archaeological data collection, that of a distributional or "non-site" approach (Camilli 1986; Irwin-Williams 1985; Pierce and Durand 1985).

In turn, each of these explanatory directions will be summarized and commented upon.

THE BEGINNINGS OF EL PASO ARCHAEOLOGY: CULTURAL INTERACTIONS AND RELATIONSHIPS

In every region, there is an archaeological "founder" -- the first archaeologist to focus on the region's archaeological record and to advance explanations of it. In the El Paso area, this archaeologist is Donald Lehmer, and his early publication on the Jornada Branch of the Mogollon (Lehmer 1948) is cited in virtually every subsequent work. Lehmer was soon to go on to work in the middle Missouri Valley, forsaking the El Paso area, but his early formulations formed the basis about which later archaeologists have characterized the archaeology there.

Lehmer postulated a series of archaeological cultures which occupied the region. In the El Paso area, he traced a cultural progression from the Paleoindian, through the Archaic, to the Jornada Mogollon and its descendants (Lehmer 1948). He divided the Jornada Branch of the Mogollon into two sets of three phases, which figure in archaeological reconstructions to this day.
These are:

	North	South
Late	San Andres	El Paso
	Three Rivers	Dona Ana
Early	Capitan	Mesilla

The early phases of this formative Mogollon period grew out of the Hueco Phase (Archaic), which exhibited sites containing basketry, matting, atlatls, sandals, bow drills, and "planting sticks" in both caves and open sites. Choppers, blades, knives, drills, projectile points, manos and metates, pestles and mortars, shell beads, bracelets, and pendants are also found in Hueco sites. These people followed a "basic Cochise pattern" (Lehmer 1948:73) of subsistence, at a "low level of development" (p. 73) although they raised corn, squash, and beans as well as cotton, and hunted deer, small game, and used wild plant foods.

Quite suddenly, according to Lehmer, the Formative Phase grew out of the Hueco. In the Mesilla Phase, rectangular and circular pithouses are found, and El Paso Brownware ceramics appear, "...undoubtedly a native product" (Lehmer 1948:74). A few "foreign" (p. 74) pottery types are also found, including Mimbres Black-on-white, San Francisco Red, and Alma Plain.

Shortly thereafter, the Dona Ana Phase begins, indicated by the shift to a combination of El Paso Brown combined with El Paso Polychrome pottery. "Intrusive wares" include (Lehmer 1948:75) Mimbres classic Black-on-white, San Francisco Red, Alma Plain, and Mimbres Corrugated, as well as newly appearing Chupadero Black-on-white, Three Rivers Red-on-terracotta, and St. Johns Polychrome. The Dona Ana Phase, Lehmer (1948) postulates, developed directly from the Mesilla Phase.

At about A.D. 1200, Lehmer's (1948) El Paso Phase appears, diagnosed by surface structures, lack of undercut storage pits, and adobe "altars." El Paso Polychrome dominates the ceramic assemblage at this time, and no fewer than 11 types of intrusive ceramic types are found on such sites.

Lehmer attributes changes between these Formative phases to influences between culture areas in the southwestern portions of New Mexico, Arizona, and Texas. This is not an explanatory direction ignored by later researchers.

Marshall (1973) also explores such a direction in his explanation of formative development. The Jornada Mogollon, he notes, is classified under Willey's (1963, 1966) period-area-subarea scheme, and Gladwin's (1934) root-stem-branch system as the Jornada Branch of the Mogollon Subarea. For Marshall, different sites are "affiliated" (1973:81) with others due to the inclusion of multiple ceramic types, while others exhibit "intrusive" wares indicative of contacts "with formative cultures on the west and northwest" (1973:81). These sites are not only dated by the pottery they contain, but the pottery types found there are used to date affiliations. At the Hatch Site, a Mesilla Phase formative site, 44 percent of the total ceramics in the southern portion of the site are El Paso wares indicating an affiliation with the southern Jornada, while 54 percent are western Mogollon wares also suggesting another, outside affiliation (Marshall 1963:88).

Concepts that should be evaluated under such a paradigm include the meaning of "affiliated" and "intrusive." Some 15 years (in the case of Lehmer's formulations, 40 years!) after such things were written, it is easy enough to criticize them. That is not the intent here. Rather, they will be evaluated in behavioral terms. If these terms imply some sort of interactive or trade relationship between groups of people who were removed from one another by a few hundred miles at most, it is not surprising that their material products are found in their neighbors' sites. Certainly, people who lived so closely together dealt with one another on some sort of level. But on what level? Today, for example, Japanese cameras and stereos are used, but not much of Japanese culture is utilized. In fact, parts of their culture may quite consciously be rejected. This may have been the case in the El Paso area in the past, as well, and this makes the evaluation of affiliation and intrusiveness difficult. Is the inclusion of pottery made outside the immediate area of a site any criterion for postulating cultural causality?

Given these problems, cultural relationships postulated on the basis of the inclusion of different ceramics in sites (e.g., Ravesloot 1985a, 1985b) must be carefully evaluated. Although the possibility will not be dismissed, most present researchers in the area have shied away from such explanations in their formulations, and for the present this report will do the same.

CULTURAL-EVOLUTIONARY EXPLANATIONS

Fortunately, most more recent archaeologists (beginning in the late 1970's) have shifted away from using difficult-to-define cultural affiliational ideas in their explanation of changes in the observed archaeological record in the El Paso region.

It should be noted that these "changes" are, however, essentially the same changes, between the same "cultural periods," that were derived by previous archaeologists. There has been little change, or perhaps none, in later years in the cultural period formulations of archaeologists. The typical archaeological sequence in all parts of the United States is initiated by a "founding father." Subsequent archaeologists working in a region usually adhere to the cultural stages postulated earlier, although the general pattern is to agree substantially with what has been set down before, but to disagree just a bit with it.

Such disagreement usually consists of accepting the previous formulations in general, but adding to them to help "round out" the cultural sequence in order to accommodate new data to it. New sub-periods or sub-phases are added. In the El Paso area, this is not strictly the case. In one example, the Dona Ana subphase was at first discounted, and then resurrected. This will be discussed at greater length below.

Beginning in the late 1970's, explanations of culture change in the El Paso area based on influence and interaction began to be replaced by formulations that depended, instead, on mechanisms which were attributed to cultural evolution. This explanatory mechanism is very different than that of "influence", but the cultural sequences that it is used to explain are for the most part the same as were postulated previously. It holds that the people who lived in the El Paso study area developed through a series of broad stages in which they behaved very differently as a natural consequence of cultural growth resulting from the increased necessity for accommodating greater population to the environment, or as an outgrowth of some other reason for needing to increase their adaptive efficiency. An immediate criticism of this approach is that there is nowhere in the literature any statement of why these people would have to increase their efficiency other than an assumed population growth, which is in turn inferred in a circular manner (an issue dealt with below).

It is a universal archaeological tendency to see evolutionary advancement in one's study area through time; we want "our people" to get more and more advanced, and search for all sorts of ways to explain how they are doing so. This is definitely a recent impetus to archaeological explanation in the El Paso area.

Through time, the scenario which dominates the evolutionary explanation of El Paso archaeological changes holds, people became more responsive to the exigencies of their environment. Either this was necessary because of increased population, or it simply took place as a consequence of selection.

The documentation of an evolutionary progression of cultural stages in the El Paso archaeological area was brought on by an "explosion" (Whalen 1980:3; Carmichael 1983:6) of cultural resources management survey in that area. There was a dramatic increase in archaeological survey activity in this area in the late 1970's, and many thousands of acres were surveyed, using various methods and with various results.

The first large cultural resources survey in the El Paso area, in the sense of looking for archaeological remains under the threat of destruction from Army ordnance and exercise activity, took place in 1976 in the Tularosa Basin and was conducted by Beckes (1977). It should be noted that surveys of specific areas for such specific purposes concentrate on the description of the resources there, rather than some sort of "fitting" of these resources to a more regional overview. Beckes (1977) survey was no different, and was directed to those data that were there. While he found Paleoindian and Archaic sites, 55 percent of the sites he found were assigned to the Formative period -- between A.D. 900 and 1375. Although Beckes (1977) did not explicitly define site recognition criteria, two general types of sites were discriminated: (1) those exhibiting "multiple on-site activities (i.e. base camps)" (1977:115), and (2) sites with "relatively limited" (1977:115) activities represented, suggesting short-term camping and procurement of specific resources. Although Beckes' survey report did not specify the criteria by which these two types of sites were distinguished, it is interesting that his taxonomy of sites persists to this day among archaeologists in the area.

Beckes accepts the "standard" chronology defined earlier by Lehmer (1948), saying that the Mesilla Phase in the area lasted between A.D. 900-1100, the Dona Ana between 1100-1200, and the El Paso Phase between A.D. 1250 and 1375. The Formative, for Beckes, grew out of the Archaic as a natural coincidence, the "logical development and refinement of pre-existing exploitative techniques" (Beckes 1977:174), involving the broad exploitation of a variety of resources in a scheduled manner. Distinctive ecological zones were exploited in a scheduled pattern, according to Beckes -- something that will be repeated in later interpretations of the area.

Beckes (1977) decided that the Mesilla Phases' mixed subsistence, focusing on horticulture, shifted in the Dona Ana Phase and to an even greater degree in the El Paso Phase to a dependence on agriculture on the basis of the existence of large, permanent lowland villages and enormous amounts of "imported wares" (p. 188).

Another early cultural resource management survey reported on by Skelton et al. (1981), the first that could be found which detailed the survey methods used, was conducted on the US Army Dona Ana missile range. A randomly selected 10 percent sample of that area, totaling 960 square kilometers, was surveyed and archaeologists discovered 198 prehistoric sites. The sites found during this survey, conducted in July 1977, were for the most part located in sand dunes and were divided on the basis of ceramic types and features into the following site functional designations:

	Mesilla Phase	El Paso Phase
Villages	1	9
Large Camp Complexes	7	4
Camp Complexes	23	8
Small Camps	23	11
Ceramic Scatters	1	1
Ceramic/Chipped Stone	6	2

There is some confusion, it must be noted, about the ceramic criteria used by Skelton et al. (1981) to define El Paso Phase sites. The criteria for defining Formative Phases used by other investigators will be discussed at greater length below.

If any archaeologist could be characterized as contributing to that previously cited "explosion" of archaeology in the late 1970's in the El Paso area, it is Michael Whalen whose first large-scale survey in the El Paso region covered 103 square miles of the Fort Bliss Maneuver Area on the eastern side of the Hueco Bolson (Whalen 1977). The paradigm with which this survey and those subsequent to it were approached is based on the view that cultural systems are "open adaptive systems" (Whalen 1977:1) which exchange energy, matter, and information with the physical environment, and which change their "structures in the face of physical and cultural environmental fluctuations" in order to accomplish these exchanges at the "least possible cost" (Whalen 1977:1).

Different types of past systems organization in the Hueco Bolson were identified as Paleoindian prior to 6000 B.C. and Archaic, Desert Culture, or Hueco Basketmaker beginning immediately after the Paleoindian period. These were followed, beginning about A.D. 500-600, by first the Mesilla and then the El Paso Phases, during which sedentism and agricultural dependence intensified.

Whalen's survey method consisted of the inspection of "100%" of the landscape, using transect intervals of between 20 millimeter and 60 millimeter spacing "according to terrain and artifact density. All artifacts were recorded on aerial photos" (Whalen 1977:12). Within the 103 square miles "virtually all exposed sites" (Whalen 1977:v) were found and mapped, "414 prehistoric sites having 429 separate occupations" (Whalen 1977:15) were found. There were no really "definitive" (1977:15) preceramic occupations, but one ridgetop was found which was covered with a thin but continuous chipped stone scatter some 10 hectares in area. It was deemed to be Archaic because ceramics were "conspicuously absent" (1977:15).

Ceramic period sites were numerous, however, and many could be ascribed to either the Mesilla Phase (A.D. 500-1150) or the El Paso Phase (A.D. 1150-1400) on the basis of their ceramics. Survey results included the location of 60 sites containing diagnostic El Paso undecorated brownware, and with a combined area of 53.2 hectares, which were assigned to the Mesilla, while 220 sites with a combined area of 172.7 hectares and containing El Paso polychrome ware were designated El Paso Phase. The remaining 149 sites were unidentifiable but are, Whalen (1977) feels, probably mostly also Mesilla or El Paso. The unidentifiable sites contain no diagnostic ceramics, and together cover only 11ha, suggesting they are "tiny camps" (1977:16).

Isolated artifacts were also found, but were not considered to be sites: "A site is defined here as a discrete activity area... Isolated artifacts, however, were not considered to be sites" (Whalen 1977:20), nor were isolated hearths. Their numbers are not recorded although it is suggested that there were thousands. "Smearing" (1977:20) by natural processes was thought to be responsible for the sparse but continuous scatter of isolated occurrences across the landscape between real sites.

Based primarily on site areas but also to some extent on site contents, seven site types were distinguished, and their probable number of occupants deduced:

1. Small camps, 0.01-.5 hectares, presumably special purpose locations, number of inhabitants

2. Large camps, 5 hectares, not estimated

3. Hamlets, 0.5-1.5 hectares, 20 people

4. Small Villages, 1.5-3.5 hectares, 20-40 people

5. Medium Villages, 3.5-6.0 hectares 40-60 people

6. Large Villages, 6-10 hectares, 120-240 people

7. Caves and rockshelters, no estimate

The smallest site class, camps, contain low densities of artifacts, primarily of chipped stone. Hamlets contain a wide variety of refuse with chipped stone and ground stone present in abundance. Ceramic density is moderate to light. In addition to containing a larger variety of artifacts, small animal bone, and non-utilitarian objects, numerous hearths are also present at village sites.

Since Whalen's 100 percent survey resulted in discovering nearly all of the sites in the survey area, he felt that his figures "...very closely represent the total number of communities which existed... in Mesilla and El Paso times" (1977:137). Population figures for different time periods were therefore derived by multiplying numbers of sites by numbers of occupants. During El Paso times, obviously, there was a much greater population living within the eastern Hueco Bolson study area, and more site types as well, indicating more specialization. In addition, it was noted that the El Paso Phase sites are more clustered than those from the Mesilla.

Whalen suggests that while the Mesilla people exploited all environmental zones in the area relatively evenly, and were only partially dependent on agriculture, the El Paso Phase was a "highly specialized agricultural/collecting subsistence economy" consisting of the "same sorts of basic subsistence activities as before but intensified and specialized as never before," with "subsistence efficiency ...markedly increased" (Whalen 1977:140). Clustering of El Paso Phase sites was occasioned by increased agricultural intensity on alluvial fans where runoff water could be utilized.

The denser and more intensified agricultural communities of El Paso times called, in turn, for increased social efficiency. In the Mesilla, a few scattered groups with ephemeral social organization utilized undecorated pottery, expediently gathered lithic materials, and had little in the way of exotic trade goods. In the El Paso Phase, however, there were "much greater problems organizing and integrating society" (Whalen 1977:144), and ceremonial rooms, caches, nonlocal shell ornaments, and decorated ceramics speak of intra- and extra-regional integration, although still at a "tribal level" (1977:144).

Whalen's survey was extended to cover the western portion of the Hueco Bolson the next season, and in this additional 77.02 square mile survey area, examined at "about 30 meter intervals" (Whalen 1978:12) an additional 1,421 prehistoric sites were found. Of these, 115 were identified as Mesilla (covering a combined area of 45.1 hectares), and 123 as El Paso (totaling 72.2 hectares). The remainder, 1,183 sites, could not be assigned to a phase, but most of these were noted to be quite small, with a mean area of 0.04 hectare. Average sizes of Mesilla and El Paso sites were 0.39 hectare and 0.59 hectare, respectively.

Excavations of a sample of small camps in a 16 square kilometer area (Whalen 1980) yielded additional information on time placement and function. The camps were interpreted to have been used for short periods during which the occupants carried out a small range of activities and in which few tools were used.

In a recent publication, Whalen (1985) amplifies his cultural evolutionary sequence. During the late Archaic or early pithouse period, groups moved between intermittent water sources during the summer and fall in the Hueco Bolson, foraging for plant foods and occasionally participating in "plant and leave" agriculture (Whalen 1985:99). In the winter, they located their base camps near reliable water at springs near the basin edge, and hunted and gathered from these locations. This settlement pattern is characterized as a "circulating" or "circular" one (Whalen 1985:100), with population circulating between long- and short-term camps.

During the subsequent late pithouse period (Mesilla) and into Pueblo (El Paso) times, semi-permanent habitation sites with high densities and variety of debris formed the focus of a "radiating" (Whalen 1985:101) settlement pattern which also included less sedentary "major camps" in seasonally productive parts of the basin and many ephemeral special purpose camps attached to each of the previous types. All of these types are found in the Mesilla and El Paso Phases within the Hueco Bolson, which constituted, at least implicitly, a closed system.

The key to validating the above model and the characterization of intermontane basins as the foci of year-round utilization rather than seasonally used areas (as O'Laughlin (1981) and Carmichael (1982) have argued) according to Whalen (1985:102-107) lies in identification of winter base camps. If site size, artifact density, and basin-edge location do indeed indicate semi-permanent residences, Whalen feels that the idea of "in situ" development of Hueco Bolson Pithouse period populations is supported.

Carmichael (1981, 1983a,1983b, 1984, 1985) has adopted a somewhat different culture-evolutionary approach to explaining El Paso archaeology. Also based on extensive field investigations and data on many archaeological occurrences, Carmichael's evolutionary scenario differs basically from Whalen's in emphasizing that the Hueco Bolson -- and other basins in the area -- could not have been the entire area exploited by any prehistoric group.

Instead, Carmichael feels that nearly all archaeological sites in such basins, until the Transitional Pueblo period (after A.D. 1150, or following the Mesilla Phase), were probably non-residential. Mesilla Phase sites in basins, rather than representing all parts of these peoples' seasonal round, are, argues Carmichael (1981), only short-term, special purpose foraging locations. To refute the residential nature of Whalen's supposed semi-permanent Mesilla habitation sites, Carmichael takes issue with the former's site typology, rejecting site size as a functional indicator. Size, Carmichael counters, is primarily a function of visibility (caused by site boundary smearing) and multicomponency (after O'Laughlin 1980, 1981) rather than a function of residential vs. nonresidential locations.

The occurrence of middens, Carmichael (1981) instead feels, is a far better criterion for determining residences (or the lack thereof, which is crucial to demonstrating that Mesilla Phase sites were not residential). A site is residential if it contains a trash midden -- that is, if it contains a defined deposit of trash rather than simply a general trash scatter. Only 2 percent of the Mesilla Phase sites in the basins are found to have defined trash middens. This suggests, Carmichael (1981) goes on, that Mesilla Phase people did not generally reside within the basins year-round, but simply gathered and processed plant foods, probably mesquite, at small locations scattered almost randomly across basin floors and margins. Their permanent winter sites were located along the Rio Grande. The Mesilla people, then, pursued a specialized rather than broad-spectrum economy, with differentiation of site functions throughout the year.

The "fluctuation model of culture history" advocated by Carmichael (1985: 117) thus views the Mesilla Phase "as a period of relative efficiency. A dispersed mobile population is indicated and use of the basin floor was probably for short-term gathering activities." In contrast, the Dona Ana and El Paso Phases fit the expectations for a "power drive [increased population growth and increased rates of production], with evidence for patterns of aggregation which were relatively short lived". Countering claims for an "in situ" population growth within the Hueco Bolson, Carmichael's model of seasonal use of the basin interior prior to about A.D. 1150 is based on the fact that few Mesilla Phase sites recorded during surface survey evidence trash middens and on the dispersed nature of settlement pattern which is similar to that of sites assigned to earlier hunter-gatherer occupation of the area.

The desert basin, thus, became a "targeted resource zone, generally exploited from outside its confines" (Carmichael 1985b:58). Collection of mesquite, agave, yucca and grass seed resources was carried out by "highly mobile foraging groups. The most permanent sites, probably occupied through the winter at least, could be expected to occur along the Rio Grande, and possibly in other areas of permanent water [canyons with springs]. The interior basin would most likely be utilized during the summer, when their relatively homogeneous biotic resources are most productive. This homogeneity could also be expected to condition the dispersed settlement pattern observed for pre-puebloan groups" (Carmichael 1985b:65).

Focusing on the period between A.D. 1150 and 1250, Carmichael (1984, 1985b:53) suggests that Transitional Pueblo (after Whalen 1980) settlement components "provide the first indication of settled [permanent residences?] occupation in the southern Tularosa and adjacent basin areas" which represents an "expansion of agricultural subsystems into an area marginally suited to that technology". He proposes to augment identification criteria for Transitional residential sites, associated ceramics and features, with the additional criteria of trash middens, the relative absence of biface reduction flakes, reliance on rhyolites and silicified shales in contrast to earlier frequent use of cherts, and site locations "within runoff zones adjacent to upland areas" and "near playa complexes" (Carmichael 1984:18, 1985b:47-49). The clustering of sites so identified in these areas departs from a pattern of "generalized" distribution of earlier Mesilla Phase sites which he believes indicates seasonal collecting and hunting in desert basins.

Carmichael supports his interpretations by recourse to data collected during a 991 square kilometer survey of the Dona Ana Range in a part of the Tularosa Basin (Carmichael 1983a, 1983b). During this survey, a total of 6,061 archaeological sites were discovered, or a total of about 6 sites per square kilometer. Sites were separated from isolated occurrences by defining a site as 10 or more artifacts found within a 30 meter radius; isolated occurrences (IO's) had less than 10 artifacts and lack features of any kind. Two site types were distinguished on the basis of size and contents. Group II sites were small, containing up to three hearths but no structures or trash middens. Group I sites contain structures or implied structures (based on the presence of "barrow" (sic) (Carmichael 1981:53) pits from which earth was excavated to manufacture adobe, have more than three hearths, or consist of more than three contiguous blowouts containing artifacts.

A problem was encountered in applying the diagnostic ceramic criteria to some of

Carmichael's (1983a, 1983b) sites. Previous researchers had diagnosed Mesilla Phase sites as those containing only undecorated El Paso wares, while El Paso Phase sites contain only El Paso polychrome wares. In some of Carmichael's sites, however, both undecorated and decorated El Paso brownwares were found. These sites were placed at between A.D. 1000 and 1250 on the basis of the inclusion of intrusive decorated wares, roughly in the middle of the formative period, at just about the time that Lehmer (1948) had designated the Dona Ana Phase, which was therefore resurrected by Carmichael.

A total of 544 "components" (Carmichael 1983a:88) among Carmichael's 6,061 sites were assignable to cultural periods on the basis of projectile point styles, pottery types, a rim sherd index, and a lithic diversity index comparing number of chert types with the total number of lithic types on sites:

	Group I	Group II	Total
Paleoindian	37	13	50
Archaic	135	108	243
Mesilla	162	94	256
Dona Ana	70	13	83
El Paso	140	45	185
TOTALS	544	273	817

Whereas Whalen professed to see very few multicomponent sites, Carmichael identified many which he attributes to "severe erosion" as well as revisitation of "favored loci" (Carmichael 1983a:90). As a consequence, 21 percent of his Mesilla and Dona Ana Phase sites and 31 percent of his El Paso sites contain what may be ambiguous deposits. This reduces the number of formative period sites that can actually be placed in one or another phase to 394 sites.

Using identifiable sites, Carmichael calculates how many components (i.e. sites) per year occur in each period, concluding that there is "increasing occupational intensity throughout the sequence as might be expected" (1983a:96). The number of sites per period in different landform categories is used as the basis for discussing shifting settlement patterns.

Particularly important in Carmichael's arguments is the identification of long-term habitation sites (LTHs)(Carmichael 1983a:100) which are indicated by defined trash middens and are assumed to have been inhabited for several months or more. The existence of trash middens implies "the existence of resources which are consumed and discarded at the site. A sufficient longevity is indicated to allow the accumulation of refuse. It is presumably this longevity and accumulation which supplies the impetus for formalized patterns of disposal represented in the middens themselves" (Carmichael 1983a:101).

Modeling settlement patterns, Carmichael (1983a) states, requires:

1. Ways to establish the contemporaneity of sites;

2. A way to establish the relative intensity of the occupation of sites;

3. A way to model the position of individual sites within the annual subsistence round; and

4. the necessity of providing at least a general interpretation of site functions.

Using such information derived from his site survey, Carmichael deduces that from Paleoindian through Mesilla times, basins in the area were occupied for specialized, short-term gathering purposes, with LTHs being located elsewhere, outside basins. With the onset of the Dona Ana Phase, larger and more permanent habitation sites became clustered in water runoff zones at the lower ends of alluvial fans; in fact, 45 percent of all identified Dona Ana Phase sites qualify as LTHs. The Dona Ana period, he adds, is not actually transitional but very similar to the El Paso period, with a similar occupational intensity. Large El Paso sites, however, tend to cluster on basin floors near large closed basins or playas, rather than on alluvial fans (Carmichael 1984). Since the Dona Ana Phase may have supported an even more complex settlement pattern and perhaps denser population than the following El Paso, Carmichael characterizes change during this part of the evolutionary sequence there as "non-linear, or fluctuating, culture change" (Carmichael 1984:14).

Later, Carmichael's (1985a, 1985b) position concerning the transitionality of the Dona Ana Phase seems to have changed, when Harpending and Bertram's (1975) argument that periods of change in cultural sequences may be relatively invisible archaeologically is used to explain the small number (68) of Dona Ana "transitional components" (Carmichael 1985a:46) found on the Dona Ana Range. The trajectory of change during the Formative period, however, is still seen as fluctuating, with Dona Ana sites being more clustered and more specialized than those of the El Paso Phase, and the increasing likelihood of greater mobility and subsistence generality near the close of Puebloan times (Carmichael 1985b).

CULTURAL-EVOLUTIONARY EXPLANATIONS AND EL PASO AREA ARCHAEOLOGY: A DISCUSSION AND EVALUATION

The cultural-evolutionary explanations of El Paso area archaeology outlined above seem to be a distinct improvement on using "influences" or "affiliations" as causal mechanisms. In addition, they are based on the consideration of a large body of data, unlike earlier formulations which relied on collections from a few sites. In this section, an evaluation will be made on whether they contribute any more than earlier studies to our understanding of the archaeological record and its causes in the El Paso area. The goal of this section, however, is not solely to criticize archaeology in that area, but to examine some of the problems with seemingly scientific archaeology in general.

Unoperational Field Methods

This discussion will begin with some of the shortcomings of cultural evolutionary archaeology in this area at the most basic level: that of field methods. El Paso area cultural evolutionary archaeology seems to be based on lots of systematic data collection -- but is it? This question is vitally important, because if data collection is not systematic and comparable within and between surveys, the very foundations upon which explanations are built are missing. El Paso area cultural evolutionary archaeology, like virtually all similar American archaeology, may well have such problems due to inconsistent data recording, largely engendered using "sites" as units of discovery, data collection, and analysis. This problem will be discussed here in the simplest of methodological terms, beginning with inconsistent and in fact unoperational "site" versus "isolated object" definitions. It might be casually assumed that if each archaeologist adheres to an explicit definition, and completely records all data, then inconsistencies can be "taken into account" or corrected for. In order for this to be the case, however, definitions have to be workable. This may well not be the case with the El Paso area surveys discussed above, for a number of reasons.

One of these is the assumption that "100%" of the archaeological materials, or of the sites in an area, are discovered using "20-60 meter transect intervals according to terrain and artifact density" (Whalen 1977:12). How, in fact, does one adjust the transect interval for terrain or artifact density? Is closer or farther survey justified when artifacts are dense? These questions simply cannot be answered, because one does not know what lies between the thin swath (certainly no more than 5 meters on each side of a surveyor for small flakes and sherds, even in ideal terrain) of items that are seen by the archaeologist. If, in fact, surveyors can detect cultural materials up to 5 meters on either side of their survey transect, then at a 60 meter interval about 16 percent of the total surface area is covered, and at a 20 meter interval 50 percent will be seen. The reality is probably somewhere between these two figures, if 5 meters on each side of a transect is not a generous estimate.

Another way of looking at the effects of transect interval spacing is to use a measure employed by engineers looking for periodic phenomena using measuring instruments. The Nyquist Criterion (Gillespie 1980:162-163) holds that in order to detect all instances of periodic phenomena, one must measure these at a sample frequency of twice the smallest population frequency to be detected. This means that at a 60-meter sampling interval, the smallest site that will always be faithfully detected would be 120 meters in the dimension perpendicular to the sample swath. At 20 meter intervals, the smallest sites that could be detected would be those 40 meter across. These are relatively "huge" sites, as will be amplified upon below. Sites any smaller than this would be underrepresented to an unknowable degree.

Even intuitively, at any rate, it is absolutely impossible to accept that any archaeologist can believe that such survey discovers "virtually all exposed sites" (Whallon 1979:v), unless one has a preconceived notion that sites are for the most part very large, and that they vary in size from place-to-place according to terrain and density of artifacts.

Although Whalen does not explicitly state just what a "site" is, he did distinguish between sites and isolated occurrences. Isolated occurrences, it is at least implied, were plotted individually and their numbers noted on aerial photographs. The center survey crew member carried aerial photographs, and as crew members as much as 60 meters on each side called out the locations of artifacts, he mapped them. It should be kept in mind that the archaeological survey work being described here was done at least partially in mesquite and other coppice dune areas, where survey crew members even 10 meters apart might not be in clear vocal or visual contact!

Whalen is not the only archaeologist who uses unworkable methodological definitions in El Paso area archaeology, however. Carmichael (1983a, 1983b) defines sites as more than 10 artifacts, or the occurrence of features, within a 30-meter radius. This criterion is, in fact, more important in defining isolated occurrences, which contain less than 10 artifacts within what is interpreted to mean a circle with a radius of 30 meters(60 meters diameter). It is assumed that the 30-meter figure was chosen because 30-meter transect intervals were used.

In all fairness, it should be noted that virtually all archaeological definitions of "sites" suffer from a similar problem -- the impossibility or at least extreme difficulty of ever actually using them in the field. Statements about sites being areas where the densities of artifacts are greater than, say, 5 per square meter sound well-considered. But how would they actually be put into use in the field? Grids would have to be laid down, and all individual artifacts marked and counted, often over enormous areas.

Unrealistic Recording of Site Attributes?: Enormous Sizes

Site sizes are one characteristic recorded during the course of most site surveys, and a consideration of the ranges of site sizes recorded by Whalen's and Carmichael's surveys also makes one wonder about the validity of such "sites" as reflecting occupations in the past. To put it bluntly, in behavioral terms, the sites are huge. Whalen's (1977) Mesilla Phase sites average 7,850 square meters in size, while his El Paso Phase sites have a mean area of nearly 9,000 square meters. Even Whalen's "tiny camps" (1977:12) average 738 square meters. If Whalen's (1980) camp excavation results, and Carmichael's later (1985a, 1985b) arguments concerning the Mesilla Phase are believed, then these at least were specialized plant gathering locations occupied by small groups of people for short periods. Inspection of some other short-duration, small-group plant collections locations, for instance Bushmen observed by Yellen (1977), yields far smaller site sizes: 10 occupants for 9 days, 149.4 square meters; 14 occupants for 10 days, 310 square meters; 5 nuclear families for about 30 days, 581 square meters (Yellen 1977:240-245).

Just what kind of short-term small-group occupations were taking place in the basins of the El Paso area to create such huge "camps?" Carmichael admitted to between 20 and 30 percent of formative period sites in his study area being "multicomponent" sites. Given the behaviorally enormous site sizes cited by almost all authors in the study area, one wonders if virtually all of these "sites" might not be the result of many episodes of repeated use. Later in this chapter it will be suggested that they are. An alternative possibility, one which will figure in a number of other parts of this report, is that site sizes are impossible to accurately measure because "sites" are imaginary, that is -- they are imagined as the immediate consequences of behavior. This kind of consequence is very different from an "archaeological site" which in many, if not most, cases will represent the overlayered accumulation of debris from different activities and occupations. Thus, "behavioral sites" cannot be located or bounded in the continuous and overlayered materials in archaeological record.

Sample Size and Culture-Evolutionary Explanations

At first inspection, the cultural-evolutionary approaches described above seem to be based on large and valid "samples" of data -- 414 sites in the Beckes' McGregor Range survey (Beckes and Dibble 1977:33), 198 during the earliest Dona Ana Range survey (Skelton et al 1981), 414 from Whalen's first survey season (Whalen 1977) and 1,421 the next season (Whalen 1978), and 6,061 by Carmichael (1983a, 1983b). While this includes only the large surveys reported so far within the region, it implies that a total of over 8,500 sites were inspected and analyzed to arrive at a final cultural-evolutionary scenario for the study area.

Closer inspection, however, reveals that only a relatively small number of the sites discovered during these surveys can be classified as to their cultural period, phase, or affiliation. All authors waver on their distinction of definite examples of Paleoindian or Archaic sites, as a matter of fact; the only temporal or cultural periods which are explicitly identified are formative period phases, and in fact it is the formative period which figures as the primary if not the total focus of cultural-evolutionary explanation in the area. As nearly as can be determined, none of the Paleoindian or Archaic site data found during the survey are discussed to any degree. While a summary of the proportion of Beckes' (1977) sites which were classifiable cannot be found, the following table summarizes this proportion for later surveys.

Skelton et al. 1981

Sites Found: 198

Identifiable

Mesilla	61 (31%)
El Paso	35 (18%)

Whalen (1977, 1978)

Sites Found (both seasons): 1,835

Identifiable

Mesilla	175 (9.5%)
El Paso	343 (18.7%)

Carmichael (1983a, 1983b)

Sites Found: 6,061

Identifiable

Mesilla	256 (4.2%)
Dona Ana	83 (1.3%)
El Paso	185 (3.0%)

Of the total of 8,094 sites listed as discovered in the three surveys listed in this table, a total of only 1,138, or 14 percent, figured at all, then, in cultural-evolutionary explanations based on site temporal distinctions.

One might wonder what the cultural identities of all of those "unidentifiable" sites might be. Whalen emphatically states that one cannot assume that nonceramic sites are preceramic ones, and in fact believes that most of the scatters he found that did not contain sherds are really assignable to formative times (Whalen 1977, 1978). If this is the case, and even a portion of the 86 percent of the sites from the three survey listed above are Mesilla, Dona Ana, or El Paso Phase sites which happen not to have pottery, what does this do to the evolutionary sequences or density estimates per time period or landform type based on the other 14 percent? The problem would be aggravated for those phases with the smallest representation, especially the Dona Ana.

Temporal and Functional Diagnostics

A glaring problem exists in the diagnostic use of El Paso brownwares to define cultural periods within the Formative period. According to Lehmer (1948) and virtually all archaeologists who have worked after him, the presence of undecorated El Paso Brownware is diagnostic of the Mesilla Phase, and of El Paso Polychrome which indicates the El Paso Phase. Carmichael's Dona Ana Phase will be discussed shortly.

El Paso Brownware occurs primarily in the form of often large but usually small-mouthed ollas, while El Paso Polychrome is usually found in the form of wider-necked jars and bowls. El Paso Brownware can only be discerned on the basis of its rim sherds; body sherds cannot be identified as definitely as undecorated ware. This is because El Paso Polychrome is decorated on the upper 1/3 to (later) 1/2 of the vessel; any of these upper sherds is diagnostic of decorated vessels. Given these identification requirements, if one took 100 El Paso Brownware ollas and 100 El Paso Polychrome jars, broke them up into an equal number of sherds each, and scattered the sherds in a random fashion, one would expect to find many more clusters of sherds that could be identified as "El Paso Phase" than as "Mesilla Phase." If one used these clusters to determine the population during each phase, the El Paso Phase would automatically come out ahead -- which it does.

Perhaps thinking about just what these different types of El Paso Brownware might be in a behavioral sense would be better than further belaboring the conclusions of using simple counts or presence/absence of them as temporal and population size markers. Undecorated El Paso wares, like their similar-looking counterparts in most places where ceramics were used prehistorically, are quite likely to be utility wares, used for cooking and domestic tasks. El Paso Polychrome probably has other sorts of functional implications as well such as serving containers. Of course it is true that the polychrome ceramics appear later in time, but would it not be likely that utility wares would continue to be used? This was, in fact, a finding that led Carmichael (1983a, 1983b) to resurrect the then-unpopular Dona Ana period, the diagnostic of which is the co-occurrence of both decorated and undecorated El Paso Brownwares at a site. While convenient, this explanation raises some problems of its own. Would it not be expected that a group that had both of these pottery types in their larger sites might also create assemblages at other smaller sites in which just one type would be discarded? We often do this today when we recycle old dishes and utensils on camping trips. But these one-pottery-type Dona Ana sites would then become either Mesilla or El Paso sites. Could many (or most) of the Mesilla and El Paso sites in the Tularosa Basin be portions of the Dona Ana settlement system? Or could the Dona Ana sites be multiple occupied El Paso plus Mesilla sites?

Definitions of Site Function and Use

This last question brings up the problem of defining site function, for it can only be answered if one can tell if a site represents a single, long-term occupation. This is what [is assumed that] both Whalen and Carmichael mean by "residences." While it is easy to reject the notion that simple measures of size and contents unequivocally tell us about whether a site is a "residence" or not, the notion of defined trash deposits or middens as diagnostic of residences, advanced by Carmichael (1981, 1983a, 1983b) is compelling. If a site contains a defined trash deposit or midden, it is a residence because trash middens imply that resources are consumed and discarded at the site, and there was enough longevity to cause "formalized patterns of disposal" (Carmichael 1983a:101).

Just what are defined trash deposits or trash middens? Two directions might be taken in answering this question. The first is behavioral, and might be rephrased "why would people discard trash in a formalized versus haphazard manner?" Certainly not just because sites are occupied for several months, as Carmichael implies. Another perhaps more telling explanation is suggested by ethnographic observations of distinct, segregated dumping at Eskimo residences (Binford 1978:146). Eskimos carefully contain trash dumps when they intend to use the materials in these dumps at some later time. Bones, for instance, are discarded when it is likely that they will be boiled for "bone juice" and marrow extraction later in the year.

Defined trash middens may well be caches. This implies their existence in only certain kinds of sites, not necessarily residences at all, and certainly in sites that were to be reoccupied at a later time. They may also imply the use and reuse of activity areas such that the use of space must be highly structured or "formalized". This can occur at long-term residences as well as at places where processing facilities are continually reused, for example.

A second avenue for thinking about trash deposits is to acknowledge that they have to do not only with trash, but with deposition. The appearance of archaeological materials after these leave the cultural sphere and enter natural sediments is determined by the tempo or cadence between their discard and natural depositional processes (Binford 1981). If depositional events are taking place constantly, for instance the continual blowing of sand to cover trash, then organized trash disposal may be neither necessary nor possible. Sudden discard of a large amount of material between natural depositional events (or cultural depositional events such as burial or disturbance) would be much more likely to create defined trash deposits, for instance in heaps or pits. Trash deposits may, then, be indicative of sudden, very short episodes of discard, and might even be expected at large volume processing camps rather than residences.

In Search of, and Defining, Residences

Perhaps, however, none of the above questions are the right ones to ask. It is possible that the fault lies with the functional category being sought rather than its diagnostics. What is a "residence?" In the El Paso area studies outlined here, residences seem to be defined mainly on the length of stay postulated at a place -- residences are semi-permanent places where people stayed for a few months or perhaps longer. Although the return of a group to such a location is at least hinted at by Carmichael (1985a), at the same time it is implied that the several months' occupational duration that qualifies a site as a residence takes place during a single, continuous episode, resulting in defined trash deposits. While "multicomponent sites" (Carmichael 1983a:90) are also acknowledged, there are relatively few of these even in the densely-populated formative periods, and one gets the feeling that multicomponency means successive occupations by people in different formative periods, rather than reoccupation by the same people through shorter periods of time.

The studies described above assume non-residences to be specialized activity locations -- in fact, this is the entire basis of Carmichael's (1983a, 1985a) rejection of the Mesilla Phase as being self-contained within the Tularosa Basin.

Although few hunter-gatherer and incipient agricultural groups have been available for exhaustive study by anthropologists, those which have been observed suggest that such a functional site dichotomy may be difficult to substantiate over even relatively short time periods. Generalist foraging groups tend to produce only one type of site, a base or residence from which all foraging activities take place; mobility between base camps is far higher than that suggested for residences in the El Paso area. Groups which specialize in the sense that they undertake different types of activities in various places, and use a number of different sorts of mobility to get between these places, can be termed collectors (Binford 1979). Collectors have complex patterns of movement over relatively short time spans. At the base camps of collecting groups, families live, children are raised, and consumption activities take place. Foraging also takes place within a day's walk of the base camp. Outside this radius, within a much larger logistical radius, more specialized collecting trips of more than a day to as much as months -- for instance, hunting and other resource procurement activities -- are carried out by highly organized (usually male) task groups. These groups create several kinds of sites which cannot be thought of as residences.

Collecting groups shift the locations of their residential bases more slowly than foraging groups, but when critical resources such as fuel in the immediate residential area are depleted, the residence is shifted so that it is centered on a new foraging radius. This means that the new logistical radius will often include the old residential base, which is then reoccupied for logistical purposes by members of the group. This means that with any degree of specialization in resource procurement beyond simple foraging, one would expect residential bases to be re-occupied for specialized tasks -- perhaps quite intensively -- again and again through the period of, perhaps, part of a generation. Over archaeological time, this may mean that what we see in most of the archaeological record is the result of many reoccupations, for many functions, at virtually all places. If this is the case, and one cannot easily tell whether a site is a "multicomponent" one, then we cannot say how many

36

people lived at a site at one assumed time, and we cannot make statements about how many sites there were in an area per period, or per year during a period.

Assigning the designation of "residence" to clusters of archaeological materials may not be the way to understand the archaeological record, as will be amplified later in this and other sections of this report.

Evaluating Cultural Evolutionary Explanations and Formative Sequences in the El Paso Area

The above discussions have cast some doubt on whether cultural-evolutionary sequences in the El Paso area can be talked about with the ease that some archaeologists there have adopted. Uncertainties in the operationalization of field discovery and recording procedures make it difficult to say just how many "sites" of any type or period occur in different survey areas, and what their densities are through time or across space. The behaviorally-astonishing huge site sizes agreed upon by El Paso area archaeologists cast some doubt, as well, on assumptions of what has been assumed to be for the most part single-episode site use, this making population estimates based on number of sites doubtful. There are some very straightforward, simple, mechanical problems with using El Paso Brownwares to identify temporal phases. Site function may not be reliably indicated either by size or by the existence of defined trash middens. The whole notion of separating "residences" from other sites can, in fact, be argued to be a misleading pursuit.

Carmichael (1983a) argues that in order to comprehend settlement patterns and their change through time, one must be able to establish contemporaneity or the lack of it among sites, establish the intensity of sites' occupations, provide an interpretation of site function, and be able to model the position of individual sites within the annual subsistence round. The criticisms of El Paso area cultural evolutionary explanations have illustrated that there are some severe problems with the first three of these requirements; the last of these, modeling the subsistence round, has been addressed by some other recent El Paso area researchers and will be discussed below.

Evaluating Cultural Evolutionary Explanations

When any theoretical construct is allegedly built upon the force of data, as is the cultural evolutionary framework used to explain the progression of formative cultures in the El Paso area, its tenets must be examined and evaluated from the "bottom up." That is, the ways the basic data are discovered, perceived and measured, the assumptions used to interpret these data, and the ways that conclusions are reached using the data must be both reasonable as well as forming a consistent framework. The first cause for scientific suspicion concerning conclusions based on archaeological data is the lack of such evaluation and self-questioning. An introspective questioning of the cultural-evolutionary framework in the El Paso area gives one reason for such suspicion.

Given the many "problems" with this framework -- questionable definitions of the basic units of analysis, a surprisingly small sample proportion of the total number of sites found in the area actually placeable in the cultural periods that are purportedly explained, and refutable indicators of their temporal and functional membership -- interpretations other than those which seem popular in that area's literature are possible. One of these interpretations, in this author's opinion just as likely as any other, is that the entire formative cultural sequence in the region is spurious. There is no reason to believe that the periods advanced by Lehmer (1948) on the basis of examination of the ceramics from only a few sites, and supported with slightly different explanations by cultural-evolutionary archaeologists, have any analytical reality. The evidence which has been brought to bear on their explication and explanation may be simply the result of sampling error brought about by chance encounters with a small proportion of the archaeological materials in survey areas.

This is a situation which, as has been commented upon earlier, unfortunately can be found in almost all parts of the United States. Cultural chronologies are based on small samples of fortuitously located "sites" which are then interpreted using unquestioned criteria. It should not be imagined that this such unevaluated "theory" is restricted to formative periods, either. The distinction of the classic "three phase" Paleoindian/Archaic/Formative culture history may be just as doubtful in most if not all places as shorter-term stories. In any case, it is up to archaeologists to ask if this might not be the case, and until this time, the very foundations of cultural-evolutionary explanations of the archaeological record are very infirm.

El Paso Area Environmental and Subsistence System Explanations

Fortunately, at least two somewhat different explanatory directions that promise to offer more than site-oriented, cultural-evolutionary reconstructions promise have been suggested by researchers in that area. One of these is characterized as environmental and subsistence system explanations. This new direction will be discussed only briefly here because it has not yet been fully developed, at least in its manifestations in the published literature.

El Paso area environmental and subsistence systems explanations of the archaeological record were initiated in the late 1970's with the meticulous archaeobotanical work of Thomas O'Laughlin of the El Paso Centennial Museum. O'Laughlin does, in fact, still adhere to the general tripartite cultural stages scheme -- Paleoindian, Archaic, and Formative -- but examines the evidence supporting them in terms of subsistence and other resource procurement and its relation to technology, mobility, settlement, and social and other organization. In short, more than lip service is given to the concept of the "system," unlike within the cultural-evolutionary scenario where "system" is simply a name for an entity that evolves to become more efficient.

O'Laughlin's confidence that the understanding of systems lies in the interrelationships of subsistence activities to their other components is clearest in his reconstructions of Formative Period (A.D. 0 to 1400-1500) sequences and identities (O'Laughlin 1980, 1981). He characterizes the new traits appearing in the Mesilla Phase (A.D. 250 - 1200) as going along with a gradually increasing specialization in plant resources, both agricultural and nondomestic, grading into the even more intensive El Paso Phase system based on both agricultural and wild plant foods as well. The major difference between the earlier and later adaptations is the specialization of site size and function. One of the most predominant special use locations in both periods is represented by relatively small camps of 1,000 square meters or less, which were temporarily occupied and reoccupied for purposes of processing leaf succulent plants (lechuguilla, sotol, and soaptree yucca). Such processing was carried out in both small and large hearths containing fire-cracked rock and caliche. Hearths, then, are indicative of actual activities at sites and not of their identity as "residence." Hearths, and by implication these campsites, were re-used many times. Larger hearths are indicative of bulk processing for storage, which again implies re-visits to sites at different parts of the year for different functional (productive versus consumptive) purposes. Both of these activities may have been carried out by relatively large groups -- portions of several families -- so there may have been "integrative problems" even in the Early Formative, prior to much dependence on agriculture.

Differences between residences and special purpose sites, according to O'Laughlin (1980) are further obscured by the fact that much of the tool manufacture and use at short-term, but re-used, processing locations is probably expedient, while a greater proportion of the implements used at more permanent "residences" are curated. This would result in the discard of more lithic material, in the form of both implements and manufacturing debris, at special purpose locations, which would thus look "larger" if measured in terms of gross assemblage size.

O'Laughlin (1979:64-71) compares sites believed to be primarily Mesilla Phase that have brownware ceramics and features on their surfaces to excavated sites at the Transmountain Campus of El Paso Community College. These include the Northgate Site (Aten 1972, Bilbo 1972, O'Laughlin and Grieser 1973) and the Sandy Bones Site (O'Laughlin 1977). Principal differences between reviewed sites include abundance of cores, decortication flakes, unutilized and utilized flakes, groundstone implements and fire-cracked rock features. Based on excavation and analysis of the above sites and Sites 33 and 34 at the Dam in northwest El Paso, Texas (O'Laughlin 1980), O'Laughlin posits three site types. Residential sites and two types of campsites are identified on the basis of size, amount of debris, contents, and site location.

Residential sites are inhabited on more than a short-term basis. Important variables for identification are site size, density of artifacts, presence or absence of structures, variety of facilities, and presence or absence of distinct trash areas (O'Laughlin 1980:222). Camps are short-lived occupations having small site areas, low densities of artifacts, a limited variety of facilities and rarely having accumulations of trash or houses (O'Laughlin 1980:223). These are:

Camp Type 1— oriented toward seed plant and lowland leaf succulent processing. Identifiers: hearths containing burned rock or caliche, location in lowland basins, high percentages of groundstone stone artifacts with respect to the total number of lithic (chipped and ground stone) artifacts, and high percentages of chipped stone tools indicating expedient tool manufacture and discard at the camp.

Camp Type 2 -- directed toward processing upland leaf succulents.Identifiers: in the upland where lechuguilla and sotol grow, small sized (with larger camps resulting from repeated and short-lived occupations of the same area), fire-cracked rock facilities and occasionally small shallow pithouses, low artifact densities in well-defined spatial pattern with respect to features, low percentages of groundstone implements, high percentages of expediently manufactured chipped stone tools.

Robert Hard threatens to amplify existing environmental and subsistence system explanations using data from Hueco Bolson he and others have carried out, as well as elsewhere. Unfortunately, few details of Hard's data collection strategies, analyses, or conclusions have been published to date. Two of his publications (1983a, 1983b) contain what are essentially abstracts of his further work, and give some idea of the systemic directions he plans to pursue. Hard contends that the relationships between residential bases and locations, field camps, stations, and caches must be modeled in relation to the scheduling of subsistence activities throughout the annual round. Such an annual round is postulated for the late Mesilla Phase, based on changing seasonal resource availability, and centers about summer foraging vs. winter collecting. Agricultural activities were initiated along the river or on alluvial fans, then abandoned while foraging activities took place in basins where groups could take advantage of the "greatest congruence of resources" (Hard 1983a:44), mainly water, seeds, and rabbits. In the fall, water disappears in basins and resources become available in the foothills and mountains, more permanent camps are established near springs in the foothills, and stored plant foods including agricultural produce as well as deer would be eaten. Hard's (1983a, 1983b) scenario is basically the same as postulated and illustrated by ethnologists throughout the Great Basin, with the exception of the intensive use of mountain areas; it should be remembered that the "mountains" within several hundred miles of El Paso are low, dry, and relatively inhospitable. Presumably, the goal of Hard's research is the explanation of how agriculture fit into the Mesilla subsistence pattern and intensified into the El Paso Phase.

While more promising than the products of cultural-evolutionary approaches in that they acknowledge the mechanics of systems operation, environmental and subsistence system based explanations of El Paso area archaeology may suffer from some problems as well. The approach, unfortunately, is based on the discovery and characterization of clusters of material in the archaeological record as "sites." While offering a borderline acknowledgment that places have probably been reoccupied many times for different purposes, the two authors mentioned immediately above seem to imply that these reoccupations happened only at certain favored places, that these places were reoccupied by the same temporal or at least cultural groups, and that one can tell when places have not been reoccupied but are instead the product of lengthy but single episodes of occupation. This last premise is called upon especially by Hard (personal communication), and is based on the diagnostic occurrence of defined trash deposits.

Distributional Archaeological Approaches

The El Paso area is fortunate to be the stage for some very recent experiments, including work done by the NHLEP and reported on in other chapters of this report, which anticipate a new direction in archaeology that promises to change the field drastically as its implications are pursued.

Earlier in this chapter, it was emphasized that archaeology must evaluate its foundations from the "bottom up," that is, beginning with the most basic data discovery and collection methodology. Data collection must be consistent with how the archaeologist believes the archaeological record represents and what it means, that is with middle and higher-range theory. Distributional archaeology is an archaeological approach which begins with methodology.

Distributional archaeology (Ebert 1983, 1986; Ebert, Larralde, and Wandsnider 1983) is a logical continuation of archaeological directions suggested by archaeologists advocating non-site (Thomas 1971, 1972, 1973, 1975) or off-site (Foley 1980, 1981a, 1981b, 1981c, 1981d) archaeology, and is based on the realization that the archaeological record, as it is discovered and perceived by archaeologists, is a qualitatively different phenomenon than is episodic human behavior in the past. The archaeological record is separated from that past human behavior by a series of disjunctive differences, including (Ebert 1986:12-13):

1. The systemic processes of organized life, particularly mobility, labor scheduling, technological and subsistence planning, and other activities which can be see as conditioning the nature of the differential placement of human activities.

2. The behavioral events of aggregation of natural materials, their modification, and their discard, loss, and abandonment that structure the consequences of activities, creating an entrophic archaeological record, rather than one which is the sum of all human activities.

3. The interaction of behavioral and depositional events, separated by time and tempo differences which result in the overlap of multiple discard events within single depositional units, causing the archaeological record to differ from human behavioral events in the time-scale and phase of its representation.

4. Post-depositional natural and cultural processes which affect the preservation, integrity, and visibility of the archaeological record.

5. Archaeological methodology -- that is, the ways data are discovered, measured, and analyzed and the biases that these methods introduce into interpretations of their meaning.

The disjunctions, taken together, mean that one cannot walk along in the field and "see" a reflection of the past in any sense. In fact, data cannot be taken to the laboratory, or manipulated in any way, to see any sort of reflection of past episodic events. Not only is basic data, the archaeological record, different from the flow of past events -- the conclusions that can be made about the meaning of the archaeological record are going to be different from statements of past events. This is not to say that one is handicapped by some sort of "distorted" archaeological record. The archaeological record can only be seen as distorted if it is expected to directly mirror the events that happened from moment to moment in the past. The contemporary reality of the archaeological record is not distorted, and in fact it is what is there to work with.

A consideration of the disjunctures between the past (past behavior) and present (the perceptions available to archaeologists), and the long time periods of which the archaeological record has accumulated, makes it clear that the data are probably in all cases the result of the material products of not only a few, but many, small events which through even relatively short time spans form an archaeological record that is continuous through space. This is not to say that there are not clusters of materials in the archaeological record, but rather that one cannot look at these clusters in any cursory way, and perhaps not even in high-powered ways, and tell which clusters or parts of clusters were the result of bounded activities in the past. In short, sites, while they may be a useful real-time ethnographic event, do not exist in any way in the archaeological record.

If sites cannot be found in the field then they are inappropriate as units of discovery, measurement, or analysis. This has been the impetus for non-site, off-site, and distributional archaeology, which is based on the search for, discovery, mapping and plotting, characterization, and analysis of the distributions of artifacts and not sites. The "foundation" of distributional archaeology, then, is forgetting about "sites" as reflections of episodic events at all levels of archaeological research and explanation.

The mechanics of the first "non-site" or distributional survey to be applied to parts of the NHLEP area in the course of the Arizona State Museum's (ASM's) Santa Teresa Project will be outlined there. The non-site portion of this survey was spearheaded by Dr. Cynthia Irwin-Williams, who has been experimenting with the idea of distributional archaeological recording for a number of years, particularly in the Arroyo Cuervo region of New Mexico. The nearly continuous archaeological materials of this area suggested to her that it might be unrealistic to attempt to define sites in the course of in-field recording, and her portion of the ASM Santa Teresa Project followed this lead.

The ASM's field methodology in the Santa Teresa Project is outlined in a paper and the Santa Teresa report, edited by Ravesloot (1985a, 1985b). Beginning from the stance that most sites in the area could be expected to be multi-component (a somewhat different concept than that of previous investigators), but recognizing the perceived needs of managers, the ASM researchers attempted to reconcile a site survey with a non-site methodology.

Three distinct survey methods were used in their survey: a site survey method, the "Density Dependent Method" of Irwin-Williams, and in-field artifact class counts in both areas, subject to time constraints. The survey area was first stratified on the basis of a geomorphological analysis conducted by Davis and Nials (1985), which has been discussed in Chapter 2 of this report. The Davis and Nials stratification postulates differential visibility versus archaeological integrity in three separate zones within the ASM study area:

1. In the mesquite coppice area, high visibility and low archaeological integrity;

2. In an inactive sand sheet area, low visibility and high archaeological integrity; and

3. In yucca dunes, high integrity and, in different places, high to low archaeological visibility.

The logical conclusion to be drawn from the Davis and Nials stratification is that the only area where archaeological resources are possible to locate, and worth locating, is in the Yucca Dunes Zone. Fortunately, as discussed at greater length in Chapter 2, this did not limit their survey to only this zone.

Two separate phases of survey were undertaken by the ASM in their Santa Teresa survey. Phase I consisted of survey within Zone 3 using the Density Dependent Method (Ravesloot 1986:6) at a 10 percent intensity, conducted in survey units measuring 100 meters x 100 meters (in their reports, they consistently refer to these as "100m2 units," but they actually mean 100 meter x 100 meter squares, with areas of 10,000 m2 or 1 hectare in area). These units were surveyed intensively, using 20-meter transects in a "zig-zag" (Ravesloot 1985b) pattern, and all artifacts were flagged. Counts and amounts were called out to a unit recorder. Three separate sorts of manifestations were derived from these counts and amounts: sites, defined as greater than 20 items per 10 meter x 10 meter square, isolated artifacts, and isolated manifestations with "low density, but discrete, multi-artifact type surface scatters," (Ravesloot 1985b) or high density single artifact type scatters. The crew chief and an assistant followed, mapping in all manifestations -- the boundaries of isolated manifestations were mapped, and artifacts "pinpointed in sites" (1985b).

The Density Dependent Method, as outlined by Irwin-Williams (1984), is a non-site approach in which surveyors adjust their survey intensity according to the density of artifacts found. The objective of the method is to "document the large and small scale distributions of artifacts and features in space" (Irwin-Williams 1984:8). Within the 100 x 100 meter survey units artifacts and features are first discovered and all are pinflagged. A program of nested sampling procedures is then implemented on the identified distribution of items. Artifact density and dispersion, large and small scale topographic relief, and evidence of artifact redeposition each play a part in determining the sampling techniques employed: "Placement of subsequent sampling transects and recording-collection units are determined by theses initial density and dispersion-clustering observations. Collection-recording units of 10, 5, and 2.5 meters square are employed to sample progressively denser (more concentrated) spatial distributions" (Irwin-Williams 1984:9).

In the Phase II survey, Zones 1 and 2 and additional portions of Zone 3 were surveyed using traditional site survey methods. A total of 67 percent of the survey area was actually inspected, taking into account both traditional site survey and the Density Dependent Survey. The "site" density recorded was 3.08/square kilometer, which increases to 12.05/square kilometer if isolated manifestations are added to the total.

Temporal phases discovered during the survey were "crossdated" (Ravesloot 1985b:17) using brownware type, ceramic rim form, and projectile point diagnostics. These were "evaluated" (p. 17) using obsidian hydration dates. In all, 73 datable components, were defined, as well as 111 occurrences with no temporally-assignable diagnostics. "Several locations were found to possess multiple mixed components," (1985b:19), while the datable temporal components "suggest... more intensive use during the Archaic and early formative periods" (1985b:19). Additionally, carbon-14 and obsidian hydration dates indicated that several assumed Archaic projectile point types were not reliably diagnostic of this period.

Later analysis of data collected in the course of Density Dependent Survey indicated that much material was not visible due to geomorphological processes which blurred site boundaries, making them impossible to define (Ravesloot 1985b).

Artifactual material was analyzed using an assemblage diversity measure which was taken to indicate that a wide range of activities took place as many sites, and also that these sites were occupied for relatively long time periods (Ravesloot 1985a:15). In all, 34 classes of artifacts were used in this diversity measure. Most sites were found to exhibit "multiple temporal components," due to their being "deflated and mixed" (Ravesloot 1985a:16). High diversity scores for many sites indicated a wide range of procurement and processing activities had occurred there. It should be noted that this conclusion is somewhat at variance with earlier archaeologists' formulations which hold that most sites were special use locations.

An interesting analysis carried out during the course of the ASM research, seemingly independently of much of their other activities, is described by Pierce and Durand (1985). They examined the relationships between resources and the archaeological record, using assemblage summaries from each of the 100 meter x 100 meter squares that were surveyed and totally ignoring "site" boundaries. They note that the archaeological record is found everywhere, in all of those surveyed sample units, although in differing densities, and voice the opinion that site boundaries in such areas have been arbitrarily defined in previous surveys. A total of 1,259, 100 meter x 100 meter units, out of a total of 2,272 in the survey area, were treated by Pierce and Durand. They actually analyzed artifacts from 300 of these units, and on this basis feel that variations in artifact frequencies "reflect" (Pierce and Durand 1985:6) differences in the occupational intensity of portions of the landscape.

Pierce and Durand (1985) found especially high frequencies of artifacts on low scarps and ridges, near depressions, and near what they felt were good lookout areas; in fact, they calculated a view index from topographic maps and found that the units with the most artifacts had the highest "view potential" (1985:6). Distance to the Rio Grande also predicted the highest concentrations of artifacts. Pottery and groundstone, they contend, are restricted almost totally to the low scarps in the area, while chipped stone and groundstone are ubiquitous. This analysis concludes by saying that distributional archaeological approaches allow one to ask and answer questions that a site approach will not.

An Evaluation of the Arizona State Museum Distributional Survey

The ASM employed distributional survey methods in at least a portion of its Santa Teresa Project in recognition of the nature of the archaeological record there. Previous archaeologists conducting surveys in the area had looked for sites--bounded clusters of archaeological materials with areas containing virtually no materials (or at least no "diagnostic" materials worth using in their

42

theoretical constructs) between them. This, in fact, is what they found using such site-centered methods, if the many "IO's" between the "sites" are discounted (see Moore and Bailey 1980 for a discussion of unoperational IO's), which in all cases they are.

The ASM's distributional survey in the Santa Teresa area illustrates, however, that when survey is conducted using even a partially non-site methodology, an entirely different picture of the archaeological record appears. There are no bounded or boundable "sites," but instead a continuous coverage of archaeological materials--artifacts and features--across the landscape. "Continuous" does not imply "uniform" or "even," of course. The continuous archaeological record has denser and sparser spots, and artifacts are clustered at different scales. The "boundaries between sites," however, are not there when, effectively, artifacts and features are recorded as individual entities.

It is interesting that one of the responses one gets when describing distributional survey, and showing maps of the distributions of artifacts and features in an area, to cultural resource managers and archaeologists is: "Now we can look at the maps and really figure out where the sites are." After a few minutes of inspection, however, smiles fade as the frustration that is felt when trying to substantiate imaginary entities such as "sites" sets in. It is in fact when the locations of all of the visible artifacts are taken into account that "sites" are most obviously not there. Sites can only be concocted when "all those artifacts between them" are ignored. This was illustrated and recognized by at least some of the ASM researchers when attempts were made to integrate both "site" and distributional survey into the Density Dependent Survey areas. The translation could not be made. The Santa Teresa researchers might be faulted for even attempting to conduct both "site" and distributional survey in their study area, but it is more charitable to take this attempt as an experiment that didn't work, and to credit them with realizing it.

Another more substantial criticism of the ASM survey, and Irwin-Williams' non-site methodology in general, is that the Density Dependent Method must surely suffer from some of the same operational problems in the field that previously discussed site definitions do. In the Density Dependent Method (Ravesloot and Irwin-Williams 1985), survey of moderate intensity (20-meter transects) is carried out down a 100 meter-wide transect. Artifacts are point-provenienced until specific artifact densities are found, at which time both the intensity of survey is increased, and the method of recording artifacts is changed to a grid recording scheme. As artifact densities become higher, grids are made smaller.

While variable survey and recording intensity might seem only rational, in order to deal with greater and greater numbers of artifacts, two important criticisms can be leveled at it. The most straightforward is that arriving at decision points about shifts in discovery and recording methods, and then actually gridding out what can at times be very small sample squares, must be very difficult and time-consuming in the field. Although tests might be required to prove it, it might be far more efficient to maintain consistent discovery, locational mapping, and recording methods throughout survey. This is the way that the BLM's NHLEP distributional survey was carried out.

A second criticism of the Density Dependent Method might be applied to all "staged" survey methods, whether directed at finding and recording sites or artifacts and features. This is that the harder one looks, the more they will find, other things being equal. Another way of saying this is that if the distribution of artifacts over the landscape were entirely even, the archaeologist would perceive higher densities where discovery and recording (for things are discovered during recording, too) were more intense. Rather than shifting discovery and analysis intensity in response, to a differential distribution, the archaeologist may actually be creating distributions of artifacts by adjusting survey methods.

It is popular in discussions of "staged" survey to suppose that one should look harder and spend more time in areas where there are more artifacts; it is only if one thinks that the densest areas are behaviorally more important, that is that they are sites, and that the areas where artifacts and features are not as densely distributed are less important. This argument may only be defended from the standpoint of those beginning "we've always done it that way," or "cultural resource law and policy requires..." Arguments to the contrary will be presented later in this chapter in the context of how ethnographic data suggest the archaeological record is formed, as well as in other chapters in this report.

Finally, a more "theoretical" comment on some of the ASM's preliminary conclusions in the Santa Teresa Project concerns Pierce and Durand's locational generalizations. Their contention is that artifacts and features are found in high densities atop low ridges in the project area because these offer advantageous lookouts. It should be taken into account that the topographic variation in the project area is incredibly subtle, and also that there is perhaps no reason that inhabitants there would need "lookouts" if they were processing plant foods. The argument that they simply wanted lookouts involves more than a bit of mental transference and cannot, in any case, be proven. It is quite likely that much of the variation in the densities of artifacts identified in the project area are due to depositional and post-depositional factors affecting the visibility of archaeological materials, and not to any past bias in where activities were carried out. This can be illustrated in the NHLEP data, and an analysis of natural processes in the formation of the archaeological record is detailed in Chapter 8.

THE ETHNOGRAPHIC RECORD AND ITS RELEVANCE TO THE ARCHAEOLOGY OF THE EL PASO AREA

This section will explore the potential relationships between behavior and archaeological remains, as suggested by Hard (1983b), using several sources of ethnographic information. First, general patterns of group movement in mobile and semi-sedentary systems which have been observed ethnographically are discussed and the potential archaeological consequences of such patterns offered. Then, ethnographic accounts of settlement and mobility patterns, the reuse of places, modes of travel and range sizes of some basin and range forager/horticulturalists and agriculturalists are described. These patterns provide a basis in later chapters for modeling patterns of group movement for much of the prehistoric occupation of the El Paso area. A final source of ethnographic information is the historical observations made by chroniclers of Spanish expeditions traveling up the Rio Grande.

Land-Use Strategies and Occupational Histories

Ethnographically observed group mobility patterns can be demonstrated to result in the regular and casual reuse of locations. Two types of reuse, multiple occupation and reoccupation, are discussed below. Reuse of a general area for different functions produces a multiple occupation pattern. Reuse of particular places and facilities for the same function is termed reoccupation here. Arguing from the position that occupational histories of locations are variable, Binford (1982:17) has reasoned that the patterns of association among artifacts for a group of assemblages may result from regularities in the history of use of a location and not necessarily from the use of the artifacts during a single occupation. If this is so, developing expectations for assemblages associated with different types of group movement will enable characterization of land-use strategies implemented by prehistoric populations.

Patterns of Group Movement in Mobile Systems

Patterns of land-use recognized for mobile hunter-gatherers can be linked with the archaeological consequences of group movement. The configuration of a settlement system is ultimately linked with both resource-procurement practices and with the structure of resource distributions in the environment. As previously discussed, generalist foraging groups tend to produce only one type of site--the base camp from which all foraging activities take place. Groups, termed collectors (Binford 1979), organize their mobility in more complex ways, staging many different activities from their residential base camps.

Patterns of settlement behavior involving a base camp-centered strategy of land use have important implications for the reuse of locations in a settlement system, and consequently for archaeological content of places. In the logistically organized-collector system, a residential group is positioned with respect to known distributions of food, water, and fuel resources. Economic zones around the residential camp are exploited by means of different mobility strategies with an inner zone around the residential camp exploited during daily foraging trips and a surrounding logistical zone into which longer term special resource-procurement trips are made from the base camp.

In the previous section of this chapter, the consequences of moving the residential camp which include reuse of areas formerly surrounding the old camp according to different strategies of exploitation were described. One result of this land-use pattern is the reuse by special task groups of abandoned base camps which are in the logistical zone created when the residential camp was moved. Positioning of a residence with respect to known distributions of food, fuel, and water also raises the possibility that future residential bases will be located on the sites of present special-purpose camps, if these resources are distributed in a clumped pattern. A pattern of land use in which the locations of residential camps are reutilized for logistical functions, or vice versa, ensures that these locations will contain structurally complex assemblages (Binford 1978a:491).

Among mobile hunter-gatherers, the actual locations of residential camps themselves are rarely reoccupied. Yellen (1977:67) has noted that wet-season residential camps of the Dobe San are not often reoccupied in the same season because of infestation of old huts by insects and because gathering is more difficult in previously collected areas. Kua foragers in the eastern Kalahari have been attributed with similar behavior (Hitchcock 1982:331). However, the vicinity of residential camps can be reused for other functions. The pattern that emerges from other ethnographic documentation is that of multiple, overlapped occupations in the general location of old residences through a number of annual cycles. Binford (1978a:491) has described a pattern of debris from multiple overlapped occupations of different types in the vicinity of Nunamiut villages. This pattern results both from residential occupation of the area during several different seasons and from special-purpose occupation at other times. Hitchcock (1982:331) \ describes a similar situation for the Kua hunters who will seek out campsite locations in the vicinity of abandoned residential camps.

The same pattern is illustrated for the Ngatatjara of western Australia (Gould 1968:27). The Ngatatjara site of Tika-tika provides an example of a water-hole location where residential camps are repeatedly occupied at different seasons and where outlying temporary camps consisting of male visitors and hunting parties are also placed. The archaeological manifestation of this behavior is a number of "weak" artifact clusters over a large area (Gould 1980:27).

Powell's account of multiple residential occupations in an area occupied by the Utes is even more telling for archaeological analysis (Fowler and Fowler 1972:53):

> It is very rare that a site for a camp is occupied a second time and though they all go again year after year to camp near the same spring or small stream they invariably seek a new site for their bivouacs each time. When they leave a camp their bivouacs are not destroyed and so on coming to a customary camping place of the Utes, it gives the appearance of having been occupied by a very large tribe, and persons are easily led to suppose that thousands have been encamped there when in fact perhaps a small tribe of a dozen families have been the only persons who have occupied the ground for many years.

In contrast to residential camps, certain logistically used sites are more likely to maintain functional integrity through a number of residential moves (Binford 1982:16). Among the logistically organized Nunamiut (Binford 1978a:490-491) a number of special-purpose sites, including hunting stands and camps, fishing camps, and trapping camps, exhibit high incidence of reuse. Data on the use of locations by two families during the years 1947 and 1948 (Binford 1978a: Table 9.3) document reuse of locations and pre-existing facilities for 100 percent of the trapping camps, hunting stands, and fishing camps. Slightly lower percentages of hunting camps and kill sites were reused (85.5 percent and 46.5 percent, respectively, when averaged for the two families). In this example, functionally redundant debris is found on special-purpose reoccupations. The characteristic of functional redundancy ensures that assemblages at special-purpose camps are more likely to be characterized by functional specificity than by the complexity exhibited by assemblages from multiple occupations.

Patterns of Group Movement in Seasonally Sedentary Systems

Functional redundancy and site reuse are characteristics of a number of kinds of locations in less mobile systems as well. Moore (1979) documents considerable reuse of fieldhouses and shelters among Southwestern Puebloan groups. Less reuse is made of pinyon camps (Ellis 1974:167), since crops could not always be expected in the same location from year-to-year. Rather than occupied by special task groups, however, these locations are used by a residential unit. Reoccupation by residential groups of the same facilities for the same functions is more common in seasonally sedentary systems and contrasts with the reuse of places for different functions described for more mobile settlement systems.

The increasing permanence of the main residential base has been used to explain repetition in the use of particular places in more sedentary systems (Binford 1982:21). Since the function or "economic potential" of a place varies with movement of the residential group, establishment of a permanent residence results in the stabilization of the economic potential of other places as well. In addition to fieldhouses, reoccupation of locations used for others kinds of subsistence activities has been documented for more sedentary systems: saguaro cactus camps among the Papago (Underhill 1979:40), corral facilities among the Navajo (Dana Anderson, personal communication), herding shelters among Keresan groups (Ellis 1974:175), and overnight camps used during salt expeditions among the Hopi (Titiev 1937:247). Kelley's (1982:202-284) documentation of reuse of winter residences, corrals, sheep camps, and herding campsites by Navajo families near Gallup, New Mexico, indicates a period of use of over 30 years for several types of seasonal occupations. Anderson has recorded similar reuse patterns among Navajo families living on Black Mesa in northeastern Arizona (Camilli 1983: Table 4) which include the relocations of summer/fall and winter/spring residential sheep camps in the same place for periods as long as 35 years.

Reuse of seasonal camps that are essentially residential in nature may result in relatively heterogeneous assemblages, although some bias may exist at these places toward seasonal equipment. The variety of domestic maintenance gear at seasonal camps may be relatively similar to that which has been produced and discarded at more permanent habitations.

Occupational Histories and Assemblage Contents

The above examples of settlement context include three situations: reoccupation of locations and facilities for similar special-purpose functions, multiple occupation which includes residential and a variety of special-purpose functions, and reoccupation of locations and facilities by a residential group for similar functions. The first two settlement contexts are characteristic of mobile systems, while the last has been observed in more sedentary systems.

Observed differences in the occupational history of locations indicate that the functional character of occupations and the occupation history of a place must be considered together when assessing models of archaeological assemblage contents. Some general expectations for the assemblage composition and structure of occupations with different functions and use-histories can be summarized:

1. Settlement systems which include a logistically organized component can be characterized by a high degree of variability among assemblages which is directly referable to different special-purpose functions. To the extent that assemblages at special-purpose locations are produced during task-specific activities, they should represent the technological strategy carried out at these locations in a more direct manner than residential assemblages. The result is that assemblages from a given class of special-purpose locations exhibit internal consistency, both in assemblage structure and in content.

2. Variability in the content of residential sites could reflect activities carried out at different seasons or differences in duration of occupation. Contrasts between residential assemblages generated during different seasons could be expected, given major changes in subsistence activities at different times of the year (Binford 1978a:491). Major differences in group size and duration, as expressed in number of consumer days of occupation, could also produce variability among assemblages.

Assemblage structure at residential bases is due to the incremental buildup of remains. Seasonal differences in the activities performed at residential bases have important implications for this model. Though the structure of all residential assemblages in a system may be determined by incremental buildup of debris, resulting in greater assemblage variety and size with longer occupations, actual assemblage composition between individual locations may differ greatly. Regular patterns of debris accumulation as represented by proportional relationships among items should characterize residential assemblages. Assemblage content, i.e., the items forming the patterns, may differ between residences and will be referable to activities performed.

3. The structure exhibited by multiple-occupation assemblages is comparable to expectations for residential assemblages. It has been proposed that a pattern of incremental buildup of remains characterizes residential locations and that this pattern is suggested by a direct relationship between assemblage size and diversity (Camilli 1983). This relationship may not be indicative exclusively of residential use of some locations, however, but also of reuse of locations for functionally different purposes. It seems clear that with the potential for differences in the occupational histories of locations, assemblages could be generated at some locations which will be much more complex than on others. More heterogeneous assemblages of multiple occupations could be expected to be characterized by larger size of assemblages and greater variety of assemblage contents. With this occupational history, the problem becomes one of differentiating between multiple-occupation assemblages and those created at long-term residences.

Basin and Range Settlement and Mobility Observations and Interpretations

Ethnographic observations pertinent to settlement and mobility, and interpretations of these data, provide some of the most relevant ethnologic data for arriving at ideas about possible past adaptations and systems in the study area. Although their observations and reporting format are of varying quality, anthropologists studying Shoshone, Ute, Gosiute, Paiute and Apache groups have produced a large body of interpretations of settlement and mobility. Here ethnographic observations of some basin and range mobile and seasonally sedentary groups and their ethnological interpretation will be used in an attempt to arrive at ideas about possible alternative settlement and mobility characteristics including occupation types, locations, and duration of use; the sizes of occupations; the reuse of places; routes and travel; and range sizes. These ideas are not meant as specific reconstructions against which to match archaeological remains, but as characterizations of the range of behaviors which may have been incorporated into adaptations within the south-central New Mexico region.

Occupation Types, Locations, and Duration of Use

Among all of the groups studied here, the most commonly delineated specific type of occupation, and the most discussed, is the winter camp or village. The locations, sizes, duration of occupation, reuse, and other aspects of winter camps seems variable, however, and some of the reasons for this can be defined. Steward's (1938) generalization is that the mountains were too cold for northern Shoshone (he includes Shoshone, Paiute, Gosiute, and Ute) groups to winter there, and that they instead had winter camps in valleys or in the upper portion of the Artemesia belt in basins or along rivers. Winter camps were the most permanent association of families, some of which remained there constantly during those months when plant foods were not available. In the summer, Shoshone dispersed in single-family groups, and Steward does not discuss what "types" of camps they occupied then. In contrast to this general pattern, the Owens Valley Paiute, who were dependent upon stored pinyon nuts as winter food, spent the early winter in small groups in the mountains, and then moved to valley villages, presumably transporting stores there (Steward 1933).

Another general reconstruction of Shoshone occupation types (Powell 1980) proposed relatively permanent winter villages where stored foods are eaten, and dispersed hunting/gathering with occasional communal jackrabbit and antelope drives between March and October. Communal drives lasted only a few days or weeks. On this basis, Powell postulates two types of settlements plus other specialized occupations.

In a more specific example of Northern Paiute (Surprise Valley), Kelly (1934) describes places where seeds and roots were gathered and stored during the summer. Presumably at the largest or last of these the group took up residence at the beginning of winter, remained until the stored food was exhausted, and then moved on to the next storage location. Sometimes a group would stay at one place all winter, and other times they would occupy two or more places during that season. The translation of one Paiute name for such a wintering ground -- "where the river comes from the mountain into the open country" (Kelly 1934:77) -- suggests their location at canyon mouths. Gathering and caching activities took place in both lower and higher country, however, and winter caches might be located in those settings as well. Yet another type of occupation is implied by Kelly (1934) when she speaks of fall communal rabbit drives and waterfowl hunting.

Another account of northern Paiute settlement (Whiting 1950) also suggests winter camps in foothills or near lakes in basins, with locations and sizes of camps changing from year-to-year. During part of the rest of the year, families are dispersed as units, but there are also congregations of families at places and times conducive to finding spring shoots (May), gathering and storing crickets (mid-July), and gathering and storing large quantities of their most important staple, the grass seed wada (Suaeda depressa var. erecta wats.), at which time the largest number of people are together.

Roth (1981), studying the southern Paiute (Chemehuevi), distinguishes between the River and Mountain Chemehuevi on the basis of where they located their winter camps or home base. At other times of the year, Chemehuevi occupied hunting and gathering places on a "family basis," (Manners 1974:54), although during collective hunts many more people lived together for short periods.

Along the western edge of the Great Salt Desert, the Gosiute had winter camps containing conical pole huts at the edge of the mountains; during the rest of the year they were more dispersed, using only circular sage windbreaks (Malouf 1974). While Gosiute communal antelope hunts were less frequent than those of some Basin groups elsewhere, larger numbers of people came together then.

Among the Mescalero Apache, large relatively permanent camps were established around freely flowing mountain springs and streams (Basehart 1973:28). These were presumably occupied on a continuous basis during the winter since the eastern Plains of New Mexico were intensively exploited after the onset of the rainy seasons when water was available in rock holes, small gullies and temporary lakes (Basehart 1973:29). Permanent camp sites have been termed "nuclear centers" or places of "population concentration characterized by flexibility of membership at any given time" (Basehart 1973:31).

The Chiricahua Apache have been attributed with a pattern of seasonal north-south movement, wintering at lower latitudes and spending the summers in the highlands (Basehart 1959:103). The winter campsites of a number of families would cluster at a "favorite spot" which was also a base for stored vegetable products and refuge, according to Opler (1941:355). Groups were dependent on stored produce during the winter and early spring as mescal gathering did not commence until spring and seed bearing plants did not become available until midsummer.

In a similar pattern, the Papago moved between winter water sources, plant gathering camps and cultivated areas, since permanent sources of water in association with agricultural plots and foraging areas were rare (Castetter and Bell 1942:41; Joseph et al. 1949:7; Underhill 1936:10-11). Winter villages were situated near permanent sources of water, while villages adjacent to cultivated areas were occupied only when the monsoonal rains began. Winter villages consisting of a number of families living in grass huts were usually located near the mountain periphery.

Cholla and saguaro cactus camps were also occupied during the spring and summer. Residential reuse has been documented for saguaro camps by Underhill (1936:10) whose informant described returning to the same camp each year where a rough shelter had been erected and domestic gear such as a water jar, metate, and cooking pot had been stored (Castetter and Underhill 1935).

Spier (1933:20) lists 16 settlements of the "combined Maricopa communities" inhabited during the mid-1800's along the Gila River above its junction with the Salt. Scattered houses in an 1850 settlement were distributed from 150 - 200 feet apart extending for a distance of 2 miles (Spier 1933:22). Later, due to Mohave attacks, villages were settled more compactly consisting of from 20 to 30 habitations surrounded by garden and cultivated fields from which irrigation canals led to the Gila (Bartlett 1852:233). These winter/spring villages were located on higher ground above the reach of floods during these times. Summer residences in the bottomlands consisted of scattered earth-covered houses (Spier 1933:22). Mesquite-gathering and fishing expeditions set up temporary camps (Spier 1933:18).

Yumans along the lower Colorado River in 1775 are reported not to have lived in villages but to have lived in scattered houses along the bottomlands (Bolton 1930:102-103). Given this location, these were presumably summer residences; they were described as "huts of rather long poles, covered with earth on the roofs and on the sides, and somewhat excavated in the ground like a rabbit burrow" inhabited by 20 to 30 individuals (Bolton in Castetter and Bell 1951:52).

Cocopa villages on the lower course of the Colorado River located permanent houses on high ground near their fields. Those with fields subject to flooding lived in summer camps near their fields and moved to winter sites along mesas and sandhills during the winter where camps extended for a north-south distance of 7 miles (Castetter and Bell 1951:53). Camps for gathering pinyon nuts, acorns, and agave in the mountains to the west were reused (Castetter and Bell 1951:57).

Between the October/November harvest season and the first winter snows, individual Tarahumara families would move from the highlands into caves in deeper canyons, as the lower altitudes of the canyons afforded warmer winter conditions for livestock. Other families might move into caves in the higher mountains near supplies of firewood, depending on the availability of canyon rockshelters (Fried 1952:35). One summer settlement pattern consists of living at a number of agricultural plots for several weeks at a time. More substantially constructed houses and storage cabins are located near better parcels of lands (Fried 1952:91).

Southwestern Puebloan groups are known to reside in permanent villages and in most cases other "subsidiary sites" such as those listed by Ellis (1978:60) for Hopi, Zuni, Isleta, Laguna, and Santa Ana. One or two room field or farm houses from which work in the fields is undertaken are also constructed in farming areas. Field houses are occupied during the growing season and in some cases well into the autumn (Stevenson 1904). The wide variety of materials used to construct field houses (Moore 1979) attests in some cases to the expedient character of their use, and in others to the longer term maintenance of fieldhouse facilities. Moore (1979) also documents use of more ephemeral shelters or ramadas near fields.

Pinyon-picking camps were occupied from October to December by families from pueblos. The shelters at these camps were (Ellis 1978:64-65):

> ...circular to oval. At times one or more living trees were incorporated as the side supports. The room was likely to be 12 to 15 feet in diameter and the side walls 4 to 5 feet high. The base of the walls consisted of horizontally laid logs, above which were some lighter poles. Into and against these were places, thick, short bushy of juniper and pinyon which sloped somewhat inward.

Cribbed-log structures were used as field storage facilities for pinyon, juniper berries, and other wild foods.

Other Puebloan occupation types include herding and hunting shelters. Ellis (1978:65-66) lists four types of herding shelters including caves, stone-walled houses set near a cliff or talus slope, brush shelters, and dugouts which were also used when staying out overnight at distant fields.

Another series of occupations are associated with hunting practices and include unmortared stone walls and dugout pits used as hunting blinds, hunting corrals, and excavated animal traps.

Occupation Size

All Paiute and Gosiute "local community" sizes listed by Murdock (1967) are given as less than 50 persons; presumably, these are winter camp sizes. Shoshone and Bannock local community sizes are listed as 50-99 persons, except for Wind River Shoshone (100-199 persons), and Hukundika, which is simply listed as "small extended families."

According to Steward (1940:487), among the western (i.e., non-Plains) Shoshone (including northern Paiute and Gosiute) there were no "semipermanent" groups of more than 40-50 people, the maximum number who wintered in the same village. In a few lush settings, for instance the Owens Valley, groups of 200 or more persons could be found. During most of the year for most Shoshone groups, family bands averaging 6 persons were the basic economic and camp unit, although additions might bring this number to as much as 10 persons (Steward 1938:240).

Two more specific examples which can shed light not only on "site size," but also on the possible structure of settlement in winter camps, are discussed by Steward (1970). Steward observed northern Paiute in the Deep Springs Valley, 10 miles by 20 miles in size, as having 4-5 places of habitation. Fish Lake Valley, about 50 miles long but narrow, contained 8 contemporaneous occupations. Each local aggregate or family cluster contained 1-5 "camps" or nuclear families, averaging two families (Steward 1970:132). Clusters ranged from 4-29 persons, averaging 12.4, while individual nuclear families ranged from 2-12 with an average of 6.2.

Steward contrasts this with Kelly's data on Kaibab Paiute, whose minimum economic unit was also a local cluster of camps or nuclear families that traveled together hunting and seed gathering. Kaibab Paiute winter residences consisted of 1-7 "camps" or nuclear families (Steward 1970:134). "These camp sites or headquarters" (Steward 1970:134) were located at water and firewood sources. The average "camp" consisted of 7.5 persons, slightly higher than his Deep Springs Valley and Fish Lake Valley groups. The total Kaibab "camp cluster" ranged from 4 to 39 persons, averaging 12. "The winter sites, of camp clusters, were somewhat grouped in ten major areas where water sources were concentrated. ...the sites in some of these were fairly close while other were scattered within 10 to 30 miles" (Steward 1970:134).

Winter camps described by Whiting (1950) among the northern Paiute ranged from 3-10 households, with group sizes and the locations at which families wintered changing from year-to-year. These winter camps were not the largest congregations of people; this instead took place at times in the spring and fall when certain roots and grass seeds matured in relatively restricted areas for short periods of time. A northern Paiute group, the Wadatkuht in Honey Lake area of Surprise Valley (Riddell 1960), occupied winter camps as small as a single family, while another winter village had 6 houses and about 34 people.

Southern Paiute non-winter associations, according to Euler and Fowler (1966:49), consisted of small extended family groups or even "single individuals." This contemporary observation is supported by a note of Father de Smet's, from the early 1840's, that southern Paiute "are seldom seen more than two, three, or four together" (Manners 1974:87).

Camp "clusters" have also been recorded for the Chiricahua Apache. Opler (1941:183) describes a local group as consisting of a cluster of encampments in a general locality with each camp containing an extended family. In the spring, small family groups moved out to gather mescal (Basehart 1959:101). Mescalero mescal gathering parties included 4 to 10 women usually accompanied by several men, while 3 to 4 women might spend a day gathering mesquite beans (Basehart 1973:159-161).

Hunting parties involved organizing a large group. The size of a typical deer hunting party, for example, would not exceed more than 10 hunters and their families who would set up a base camp from which men would pursue game each day. Antelope hunting camps included from 4 to 6 families.

Tarahumara summer rancherias are scattered settlements composed of 3 to 20 families (Fried 1952:89-91) living from 200 meters to a half a mile apart (Kennedy 1963). According to Lumholtz's (1894) account, it was rare for more than 8 to 10 families to be found living in one place. Most households include from 2 to 8 members (Fried 1953:38-50). The winter residential group includes single households.

Cocopa upland winter residences of a single community would include the houses of 2 to 3 families with many such camps located along mesas for a distance of 7 miles (Castetter and Bell 1951:53). Between 1890 and 1900, there were 5 such communities inhabiting the lower delta region estimated to include about 1,500 people. This is undoubtedly a much reduced number from aboriginal times since the estimated number of Cocopa in 1776 was 3,000 (Castetter and Bell 1951:54).

The Kaveltcadom were observed in 1774 to have lived in "continuous villages", presumably households strung out at regular intervals, (these are thought of as communities by their inhabitants [Spier 1933:24]) for a distance of about 20 miles between the Painted Rock Mountains and Gila Bend (Castetter and Bell 1951:61). Papago villages consisted of a number of related families with several related families inhabiting cactus camps (Underhill 1936:6-10).

The 1680 figures of Fray Agustin de Vetancurt (1960) are some of the earliest population estimates given for New Mexican puebloan communities. These range from about 200 to around 2,000 individuals per pueblo. The distributions of individuals among main pueblos and outlying settlements is unknown. With respect to use of more temporary occupations, Ellis (1973:64) is explicit about the fact that members of extended families utilized Puebloan fieldhouses and discusses from 2 to 5 families going together to pick pinyon nuts.

The Reuse of Places

Although the southern Kaibab Paiute tended to reoccupy the same general locales during the winter, sheltered places where they congregated "with friends," (Manners 1974:20) — during the summer they returned to other sorts of "home bases" (1974:22) where reliable water supplies could be found at springs at the foot of plateaus. Manners also seems to suggest that not only home bases, but other sorts of locations, were reoccupied by Kaibab groups, although not necessarily annually: "While the pattern of ripening [seeds] involved erratic movements from year to year, the general territory within which the gathering might be done was limited by a group's familiarity with suitable camping places and water" (Manners 1974:77).

The Chemehuevi had winter homes bases (Roth 1981) to which they habitually returned, both in the mountains and near rivers, but they were away from these bases for the majority of the year. Chemehuevi reported on by Laird (1976:24) wintered at certain places for a number of consecutive years; in one area, all available "little valleys" were occupied by "clusters of families."

Kelly's (1934) description of Northern Paiute storage or caching during the growing season, and subsequent reuse of these foods at serial locations during the winter, leaves little doubt that plant processing or at least storage places were reoccupied within the span of a year. She does not say if they were reoccupied from year-to-year, however. Riddell's (1960) Wadatkuht (Surprise Valley Paiute) separated during their seasonal hunting and gathering rounds, but returned to their "home," i.e. a "permanent" (Riddell 1960:22) winter village year-after-year.

Some Ute groups apparently also maintained permanent winter camps in sheltered spots where food was stored, to which they returned annually (Reid 1972). Ute structures or "bivouacs" consisted of rough shelters of bark, juniper, or sage with a central hearth; each of the 10-40 families in a group traveling together had their own bivouac.

Basehart (1959:Map 5) depicts Chiricahua place names for camps in the mountains of northern Mexico and southern Arizona and New Mexico as well as those names referring to natural landmarks. Most Apachean place names refer to camping areas which are usually located near a water source (Basehart 1973:32). Such names as "big standing cottonwood", "a grove of cottonwoods", and "just spotted with trees" refer to specific places that were used over generations as hunting and residential camping places. Other place names refer to general areas that were reused.

Mention has already been made of the reuse of cactus camps by Papago families and of their reoccupation of winter and summer villages and of Tarahumara caves, rockshelters, and summer fieldhouses which were seasonally reoccupied.

The use and reuse of areas along the Gila by Yuman groups is described by Spier (1933:22):

> When someone died, his residence was burned, and the family reestablished themselves elsewhere. In fact, several related families would commonly decide to relocate. They might go but a mile or so, but this would furnish a nucleus for a new community. Other families would soon follow. Because of this, practically every inch of the valley from Sacate to Gila Crossing had at one time or another been the site of dwellings.

This phenomenon was likened to the community "constantly crawling away from its original location" (Spier 1933:83). Named temporary camps along tributaries of the Gila appear to have been reused when mesquite was gathered in their vicinity.

Clearly, Puebloan fieldhouses were reused on a seasonal basis. In addition, historic farm houses in heavily used agricultural areas often occur with debris from earlier centuries. Ellis (1973:62) offers us an example of a Nambe farm house associated with artifact assemblages from the 16th and the 19-20th centuries. Trash at Laguna herding shelters is described as ranging from sherds of the late 1700's or early 1800's to modern tin cans (Ellis 1973:66).

Travel and Routes

Early observations of Northern Ute groups by John Wesley Powell are also revealing in terms of route reuse, supporting the idea of fixed seasonal rounds and the revisiting of places. The people observed by Powell were "nomadic," traveling a "grand circuit" for several months of the year; Southern Utes accomplished this round on foot while the Northern Utes had horses.

Little specific information about travel and routes is available elsewhere in the Great Basin literature surveyed. Most maps show general and "logical" travel routes, many from the Salt Lake area and central Idaho in the west, to the Wind River Mountains and Plains and basins to the east (Murphy and Murphy 1960). Hultkrantz (1961, 1974) feels that some of the groups observed through ethnographic time in the Green River Basin were traveling through, and that others were relatively constant occupants of the Basin, either gathering and hunting there all year, or only leaving for short periods to hunt buffalo on the Plains.

Shimkin's (1947) separation of Shoshone settlement and mobility into foci, routes, and hinterlands, which he felt to be appropriate to describe these portions of the Wind River group's system, classified routes as being relatively high-mobility use of areas, with subsistence activities taking place along the way. Hinterlands are similar to routes, but presumably involve the less mobile activities of smaller groups than those along routes.

A number of Chiricahua raiding routes leading from mountain camps to towns and villages in southern New Mexico and Arizona and northern Mexico are illustrated by Basehart (1959:Map 4). An example of an annual route can be described for the tcok?anen [sic] band concentrated in southern areas of Chiricahua territory in the winter. Base camps were located in the Huachuca, Chiricahua, and Animas Mountains and the Sierra Madre. In the spring, small family groups moved out to gather mescal eventually ranging into summer camping areas. One such route of travel is described as originating in the Sierra Madre, and passing along the San Simon River via the Animas and Chiricahua Mountains. Passing the north end of the Peloncillos Mountains just south of the Gila River the route led to summer camping areas on the southwestern margins of the Burros Mountains in southwestern New Mexico. The length of this route between winter and summer gathering and camping areas exceeds 200 miles.

The Cocopa made annual trips from the lower Colorado River to the mountains of Baja California for purposes of pinyon picking, for wild sheep skins, and to trade with other groups (Castetter and Bell 1951:54). One such route led (Castetter and Bell 1951:57):

> ...westward across the Cocopa Mountains through Palm Valley on the flank of Cerro Pescadores, Agua de las Palmas being the first water place, then descended the western side and emerged near the perennial

> spring, Agua de las Mujeras. It then extended in a straight line across the plain to the mouth of Palomar Canyon at the base of Sierra Juarez,and in this canyon running water and a palm grove were encountered.

Castetter and Bell (1951:54) also describe prehistoric trade routes. Main north-south trails on both banks of the Colorado River are said to be traceable from Nevada down the river to Mexico. Another east-west trade trail in northern Arizona crossed the Mohave Desert in the latitude of the Mohave Sink and ended at the Pacific coast. It was reportedly used to bring sea shells to Arizona pueblos to trade for pottery and pigment and was later used by early explorers and military expeditions.

Long distance travel routes are not uncommon among prehistoric or historically documented groups in New Mexico. Cordell (1979:161) cites a trade corridor from Mexico to the North American Southwest via a corridor along the Florida, Conchos, and Rio Grande. Major travel routes among the northern New Mexican pueblos that converged at San Juan in the 1600's and 1700's evolved into wagon routes and eventually into three major interstate highways running north and south (Ortiz 1979:281).

Bandelier (1922) describes a trail leading north from the Rio Grande encountered by Cabeza de Vaca during his travels between 1528 and 1536 from the Texas coast to the Pacific:

> They said we should travel up the river towards the north, on which trail for seventeen days we would not find a thing to eat . . .

Range Sizes

The term "range" is meant to reflect the idea of the distances traveled by people, as well as the differential use to which they put areas of varying distances. The bits of information on range sizes that reach us through the ethnographic and ethnological literature are as fragmentary as those from other systems component categories. Several are intriguing, however.

Steward saw mobility among Great Basin groups as occurring almost entirely in the spring, summer, and fall. Particularly in the early summer, "Sometimes, if information reached them that certain [seed-bearing] species were abundant in another [mountain] range, the entire family crossed one or more valleys, traveling 30 to 40 miles to procure the harvest" (Steward 1938:18). The Owens Valley Paiute in the spring and summer moved as much as 20 miles or more in all directions from their winter camp (Steward 1933). Both of Steward's "range" descriptions here sound as though they pertain to residential mobility, in which consumers and producers move together.

Gosiute families reported by Malouf (1974) congregated from several adjacent valleys to join communal hunts about every 10 years. Malouf estimates that their yearly rounds extended over an area of "perhaps, 100 miles square" (1974:93).

Shimkin's (1947) taxonomy of Wind River Shoshone mobility into foci, routes, and hinterlands is the most explicit statement of ranges of different sorts and sizes in the ethnographic literature of the Great Basin, although the exact sizes of these ranges are not specified. Shimkin also notes that the Wind River Shoshone knew about areas considerably greater than their territory, and visited these occasionally.

An extremely wide range of territory was attributed to various Apache groups. Groups with different band memberships utilized the same geographic areas, sometimes at different seasons and other times during the same season. Bartlett (1952) described the Coppermine Apache's territory as being on both sides of the Rio Grande west to the San Franciso River and extending far into the states of Chihuahua and Sonora, but not any farther than 4 or 5 days north of the Gila River. A favorite spot of this group was Lake Guzman west of El Paso in northern Chihuahua. The Mogollon Band of the Chiricahua ranged in the Mogollon and Burros Mountains, the headwaters of the Gila and between the Gila and Mimbres rivers as far south as Mexico (Basehart 1959). The Mimbres band was located on the Rio Mimbres and between it and the Rio Grande.

The distances traversed from Papago winter villages to water sources give an idea of the amount of territory, dictated chiefly by water sources, traversed. Even though families camped as near as possible to a spring, a daily trip of from 3 to as much as 10 miles was made by the women to fetch water (Castetter and Bell 1942:42).

Cocopa agriculturalists used the delta of the Colorado River; one group occupying the delta for a distance of 15 to 20 miles in the late 1800's (Castetter and Bell 1951:55). Because of flooding on the Colorado, permanent fields could not be maintained; as a result, residences were scattered and constantly shifting. Frequent relocation of fields was unnecessary along the Gila. Cocomaricopa (Kaveltcdom) villages were concentrated in a 15 to 20-mile length of the Gila from Gila Bend down to the Painted Rock Mountains (ibid p. 60).

The Tarahumara territorial unit is approximately 15 miles in radius (Fried 1953:288). Within this area are several scattered settlements composed of a group of two to five families. The general settlement Pueblo pattern is described by Ellis (1973:60) as consisting of a "good-sized" village of some age beyond which were located permanently occupied, scattered or grouped houses. Little specific information was found concerning the amount of acreage under cultivation for individual villages in early historic times. Prior to 1700, each village was allowed a minimum of four square surrounding leagues by the Spanish, after this time formal land grants were issued to individual villages (Simmons 1979:182).

OBSERVATIONS AND INTERPRETATIONS PERTAINING TO TECHNOLOGY

Technology, as the term will be used here, refers to all stages of the manufacture and use of implements or any other culturally modified physical materials. It would be an archaeologist's dream come true to discover detailed accounts of the organization of tool manufacture and use among living groups--that is, technology within a systems context -- but of course organization is no more obvious or visible to anthropologists than to archaeologists. References to technology in the ethnographic literature, for this reason, are largely limited to mention of the appearance and use of individual tools, or lists of tools as cultural traits.

A good example of tools as cultural traits is provided by Steward (1940), who lists as typical of the native cultures of the Great Basin ollas for water carrying, baskets, and seed knives of stone, bone, and wood. Other "traits" of the seed-gathering complex are poison arrows, rodent skewers, and blinds. In a more focused previous study of the Owens Valley Paiute, Steward (1933) notes large, bifacial, ovoid or slightly pointed stone knives used with and without hafts for skinning and cutting.

Other studies directed toward Northern Paiute groups include mention of bone awls, digging sticks, and large flakes or stone blades used as knives for cutting meat and fish among the Kupadokado (ground squirrel eaters) of Humboldt Sink (Heizer 1970) and stone knives and scrapers made primarily of obsidian by the Surprise Valley Paiute (Kelly 1934). These people used two sizes of stone knives, the smaller for skinning and the larger for butchering, and carried them with their firedrills. Some smaller knives were hafted, and other were not, including "large blades which appear to be giant spearpoints" (Kelly 1934:141). Stone scrapers were used to work hides; these may have been manufactured, but may (along with the arrow points she saw being used by the Surprise Valley Paiute) have been "found archaeologically" (Kelly 1934:141) -- that is, scavenged from archaeological deposits.

Whiting (1950), also observing Northern Paiute, saw stone knives and scrapers used to flesh deerhides. The knives were of flaked obsidian or a white stone, and had 3-inch to 8-inch blades and wooden handles. A knife-like saw of flaked flint was used to cut down trees. Riddell (1960) reports stone skinning knives referred to by Northern Paiute as "people skinners," 3 1/2 inch - 4 inch long and about 1 1/2 inches wide, which were bifacially flaked over their entire surface and ovoid in shape. One end of these knives was rounded and the other pointed. A "flint" drill or punch was used for working skins, and "flint" or obsidian also used for making skin scrapers which were "shaped like an oyster shell" (Riddell 1960:50). Obsidian or flint sources were "Flint Mountain," a hill near Gerlack, Nevada, and these were also scavenged from two well-known archaeological "sites" in the area.

Dominick (1936), observing the Tukudeka (sheep eaters) in the Green River Basin and the mountains to the north, reported that most modified stone materials he found on archaeological deposits known to have been left by these people was in the form of flakes from cores.

To the south, the Southern Paiute used hafted stone knives as well as knives of bone for seed plant cutting and for butchering (Steward 1941). Steward also reported corner- and side-notched points in use in the Owens Valley, and groundstone slabs, metates, and vessels. Unhafted flakes were also used as temporary knives and scrapers for shaving wood. Euler (1964) describes flat metates, large oval manos, large stemmed points, and small triangular points in the southern archaeological record attributable to the Paiute.

Kaibab tools (Kelly 1964) included digging sticks sharpened with a stone knife, as well as stone drills and metates obtained from prehistoric deposits. Drucker (1937) noted chipped stone skin scrapers and knives in use by the Chemehuevi he observed.

Wooden agricultural implements among Pima, Papago, and Yuman groups include a digging or planting stick about 4 1/2 feet long and 2-2 1/2 inches in diameter. The lower end is flattened chiselwise for a length of about a foot. A heavy-bladed tool of mesquite or ironwood is described as a side-scraper hoe and utilized in weeding (Castetter and Bell 1952:94-95). A wooden shovel is also reported for the Pima (Castetter and Bell 1952:137).

Metates figure prominently in the processing of gathered foods and domesticates. Antelope Hill on the lower Gila was called "metate" by the Yuma who obtained stone from which to manufacture metates there.

SYSTEMS AND THEIR COMPONENTS AS SUGGESTED BY THE ETHNOHISTORIC AND ETHNOGRAPHIC RECORDS

To conclude this review of ethnographic observations and their interpretations by ethnologists, the general characteristics and components of these systems suggested by ethnographic records will be summarized. Anthropologists have ubiquitously interpreted their observations of material culture and social interactions in this area as indicating a flexible situation in which tribal or group boundaries or names are unimportant or ambiguous markers of different types of adaptations. For this reason, all of the different sorts of adaptations suggested as possibilities by accounts of relatively mobile hunter-gatherers for the El Paso area will be considered first. Some characteristics of more sedentary adaptations, with emphasis on Yuman, Pima, and Papago systems will then be considered.

Subsistence and Subsistence Strategies--Hunting and Gathering Systems

General

1. "Generalist" strategy with reliance on a wide variety of plant and animal foods.

2. Dependence on shoots and seeds beginning in spring at lowest elevations of basins, and ripening progressively at higher elevations.

3. Storage of grass seeds, insects, and possibly small game and fish; during collection of these resources, subsisting on other non-stored resources from immediate area.

4. Communal hunting of herd animals including bison, antelope, rabbit in basins, low foothills.

5. Individual hunters pursue animals (including single or small groups of those hunted communally) throughout entire area.

6. Trapping of smaller animals; often involves considerable logistic mobility.

Annual Round

7. At winter camps, reliance on stored foods and opportunistic hunting or gathering.

8. Spring foraging in lower parts of basins, along rivers and lakes, and in sand dune areas; storage of grass seeds and insects.

9. Later summer, roots and berries gathered in addition to grass seeds.

10. Fall pinyon harvesting where possible, also communal hunts or animal drives. Stored grass seeds still important.

11. Most non-food resource procurement embedded in subsistence mobility.

12. Winter camps on tributaries of major rivers, streams, or in areas with reliable springs due to water and wood availability. Water and wood availability probably not critical considerations in short-term, family camps at other times of the year.

Settlement and Mobility-- Hunting and Gathering Systems

Types and Duration of Occupation

1. Winter camps ubiquitous, but variable in location, size, duration of occupation, and reuse frequency. Located in valleys or upper portions of Artemisia belt, at canyon mouths, in foothills, basins, or near lakes and rivers or their tributaries. Expect annual reoccupation in most suggested cases.

2. Some winter camps where food was stored during spring, summer, and fall; when stored food gone, move to next camp with stored food. These are obviously reoccupied within the annual round.

3. Winter camps usually the largest regular association of families during the year, although this may be reversed for mounted groups due to winter fodder requirements.

4. Communal hunt or drive camps between March and October; maximum of a few days to a few weeks occupation. Large, short-term congregations could also be expected in areas of exceptional concentration of short time-window resources (grass, roots, insects). Both of these types of occupations might be expected to be reoccupied, but probably not annually (communal drive occupations only every 10+ years?)

Settlement Sizes

5. Maximum winter village or camp size probably 50 persons or less, sometimes single families; higher for some mounted groups.

6. During most of year, camp size 6-10 persons (family unit) for foragers.

7. "Winter camps" not necessarily congregated unit, may be spread out in family groups or "clusters" of from 4-39 persons each (average about 12), scattered within as much as a 30-mile radius. Such "winter camp" would not appear to be a single unit in the archaeological record.

8. Non-winter communal drive or hunt camps might be considerably larger than winter camps, but very short-term; same for aggregations in exceptional food areas.

The Reuse of Places

9. Reuse of appropriate locales with reliable water and wood annually during the winter months.

10. Reuse of other locations not as regular, may be either more or less often than annually.

11. Serial reuse of places where foods stored or cached during winter -- reoccupation more often than annual, for different functions.

12. Reuse of places might not involve direct superimposition of houses, features, activity areas but rather reuse of general area.

Travel and Routes

13. Reuse of routes, implies reuse of places or areas.

14. Possible high-speed travel routes going to and from areas bounding home ranges.

Range Sizes

15. Some family seed-gathering mobility involves episodic travel of 30-40 miles.

16. Normal residential mobility around winter camp ares (Owens Valley) as much as 20 miles radius.

17. Estimated annual Gosiute rounds (Malouf 1974) 100 square miles = 5-6 mile radius.

18. In addition to foraging and logistic radii, larger area of infrequent mobility of which groups had some knowledge.

Technology

1. "Material traits" of foraging seed-gathering people not simple, many planned elements: baskets, ollas, bow and arrow, large bifacial knives.

2. Nonlocal materials from some distance used by some foragers.

3. Possible major dependence on previously-used places and recycling of discarded materials, tools for raw material; reuse of previously discarded tool. Reuse and recycling may involve the use of materials cached by the later users themselves, or may span much greater time periods between initial discard and later reuse. Viewed in this way, discarded "nonlocal" lithic resources may be extremely important sources of "raw materials."

4. At least some mention of flakes from cores used as tools.

5. Skin working with knives and scrapers "shaped like an oyster shell" (Riddell 1960).

6. Discarded materials on known Tukedeka (sheep eater/foot Shoshone) occupations observed to be primarily cores and flakes.

7. Both corner- and side-notched points used contemporaneously in Great Basin.

8. Stone drills, knives used for woodworking.

Subsistence and Settlement Strategies -- Agricultural Systems

General

1. Dependence on cactus, mescal, and datil in the spring.

2. Grass seed collection in the late spring and summer. Seed collection at other times in areas with long growing seasons.

3. Hunting includes hunts for rabbit and deer, either individually or communally. Rabbits also snared and trapped.

4. Corn, the chief agricultural crop--single planting with harvest season in October/November (Tarahumara) or successive plantings which include pumpkin, beans, and squash (lower Colorado and Gila river groups).

5. Pinyon and other nuts and acorns collected in the fall.

6. Fishing as a source of meat second to jackrabbits.

Annual Round

7. Reliance on stored domesticates and gathered foods and opportuntistic hunting and gathering during the winter season.

8. Foraging for early spring greens and cactus; late spring and midsummer grass seed gathering. "Wild rice" (Uniola palmeri) collected by the Cocopa. Spring plant collecting trips also made for procurement of cactus, mescal, and datil;cactus fruit collected in midsummer.

9. Fall pinyon or ironwood nut, acorn, and mesquite gathering. Mesquite collected earlier in warmer country.

10. One or two successive plantings of cultigens, corn, beans, squash, and pumpkin chief cultigens. Some groups much more dependent on gathering and fishing (see Spier 1933:48) than on agricultural products.

11. Fall hunting parties organized for deer and antelope (Puebloan groups), deer also hunted individually.

12. Mountain sheep hunting in the spring by small groups of men.

Settlement and Mobility -- Agricultural Systems

Types and Duration of Occupation

1. Permanently inhabited residences; investment in construction of substantial buildings with adobe and stone (Southwestern Puebloan groups); shallow pithouses and huts of grass thatch used in warmer climates.

2. Winter residences at structures in caves and rockshelters.

3. Winter camps or villages near major water sources, either rivers or mountain streams and springs. Water sources critical in determining camp placement in some situations, limited space on suitable ground in others.

4. Plant collecting and fishing camps of several related families occupied for a few to several

weeks. Items are cached at reused camps in areas were collection is an annual pursuit. Hunting camps used for a week or slightly longer.

5. Seasonally occupied field houses and shelters used near fields; earth-covered pitstructures, grass huts and ramadas used contemporaneously by the same group.

6. Occupation of summer "field" villages.

Settlement Sizes

7. Winter villages or camps extending for distances of 7 miles along riverbanks for some "communities". As with hunter-gatherers, winter camps do not necessarily form congregated units but may be spread out along a mesa edge or other sheltered settings. With distances between houses of about 200 feet, the Maricopa settlement near Maricopa Wells in 1850 would have contained 50 or more families in the space of 2 miles.

8. Number of occupants recorded by Kino for Pima-Maricopa villages (presumably permanently maintained or reused winter settlements) between 1697 and 1770 were given as ranging from 40 to 200 inhabitants (Hackenburg 1974:101). Bartlett (1854:233) describes villages of 20 to 30 habitations in 1852.

9. Single-family houses near fields occupied during the growing season.

10. Plant collecting and fishing camps occupied by an extended family or small group of families.

11. Hunting camps of from 5 to 6 men.

Reuse of Places

12. Reuse of areas around reliable water sources on an annual basis.

13. Reuse of plant collecting and fishing camps in areas where resources are annually predictable; less or little reuse of camps used during foraging for spring greens and grass seeds.

14. Reuse of camping spots along travel and collecting routes.

15. Areas where raw materials other than foodstuffs are available are named and reused.

Travel and Routes

16. Long-distance trade routes going to and from areas very distant from home territories.

17. Long-distance collecting routes reused.

Range Sizes

18. Daily trips of up to 10 miles from the residence not uncommon.

19. Frequently, a wide collecting radius around winter and summer villages.

Technology

1. Containers including ceramics, basketry and netting, and gourd utensils all figure prominently in food getting and processing techniques.

2. Wooden agricultural implements.

3. Use of nonlocal (not immediately available) materials for tool production. A dark obsidian or flint found near the Salt River was used by the Maricopa along the Gila (Spier 1933:130).

4. Caching or storage of tools and containers at reused camps.

5. Use of stone knives, pestles, and abraders is mentioned for the Tarahumara (Pennington 1963:219).

6. Reuse of prehistoric implements. Stone axes found in nearby ruins were used by the Maricopa to dress metates (Spier 1944:130). Stemless, concave-based Hohokam arrow points collected by the Pimans (Russell 1908:111).

7. Straight-based, corner notched arrow points described for the Maricopa (Spier 1933:134).

Ethnographic and Historical Observations in the El Paso Region

Spanish documents chronicling the 16th and 17th centuries indicate the existence of contemporaneous semi-nomadic horticultural groups in the El Paso area and Piro groups farther to the north and those to the south near the confluence of the Conchos and Rio Grande rivers who resided in permanent pueblos.

No mention is made of the Onate Expedition encountering Indians on the portion of its route between the upper Conchos River in Mexico and the Rio Grande some 22 miles below El Paso. He did meet Indians on the Rio Grande just below El Paso reaching this spot on April 20, 1598. These Indians were called Mansos after the greeting they gave the Spanish (Schroeder 1974:143):

> On May 4 we did not travel farther than to the pass of the river and the ford (El Paso). Forty of these Indians came to the camp. They had Turkish bows, long hair cut to resemble little Milan caps, headgear made to hold down the hair and colored with blood or paint. Their first words were manxo, manxo, micos, micos by which they meant 'peaceful ones" and 'friends' (Hammond and Rey 1953:315).

Bandelier (1892:348-349) placed the Mansos "in the Mesilla Valley, somewhere near the present station of Mesquite (30 miles north of El Paso)" pointing out that:

> It is well to remember this, as the finding of Indian remains there need not be taken as evidence of a former establishment of sedentary natives. The Mansos were less nomadic than the Apaches, but they still did not dwell in permanent adobes. It is doubtful that they made pottery previous to their colonization by the church at El Paso.

From interviews in the late 1800's, Bandelier (1892:165) describes Manso material culture:

> Their dwellings were made of branches and boughs, and they tilled the soil to a limited extent, but in dress they were like the Apaches and other Indians of the plains.

According to Schroeder (1974:144), hairstyle and dress of the Mansos as given by Onate's itinerary are similar to that described for the Patarabueyes seen by Chamuscado in 1581 and Lujan in 1582. Patarabueyes are also referred to in 1601 by Juan de Ortega in testimony to the Valverde investigation (Schroeder 1974:144):

> At some estuaries of the Rio del Norte already referred to there are quantities of fish. This witness saw some Indians who they called Gorretes, or Pataragueles, catching bagres, aguajas, and coteas. As it was twenty leagues from the camp to this fishing place, neither the soldiers nor the others ever ate fish (Hammond and Rey 1953:661).

Schroeder (1974:144) states that the camp referred to above appears to be half way between El Paso and the Piro villages and that Ortega's description applies to the same general area as that ascribed to the Mansos near El Paso described by Onate. Schroeder concludes that the Mansos encountered in 1598 by Onate correspond to Paratarbueyes groups who were also found living 6 or 7 days travel below El Paso in 1581 and 1582.

Later in the 1630's, Benavides described "Mansos" Indians pointing out their dependence on fishing -- "they sustain themselves on fishes from that river (Rio del Norte, or as it was later called, Rio Grande), which are plentiful and good devouring them raw, just as they do the meat of all the animals they hunt,...(in Schroeder 1974:148)" -- and use of paint on their bodies and their hairstyle all of which Schroeder (1974:145-46) believes corresponds to the traits previously described by those in earlier expeditions for the Patarabueyes otherwise also known as Otomoacos, Jumanos, and Rayados.

Of the use of these various group names, Schroeder (1974:147-148) concludes:

> ...the Mansos were related to the general group included under the term Pararbueyes, which included the Otomoacos of Lujan in 1582, the Pararbueyes or Jumanos of Espejo in 1582, and the Pataros or Raydos of Chamuscado of 1581, all of whom might be better classed as Sumas...In short, it appears the Raydos, Ryas, Pataros, Patarbueyes, Jumanos and Mansos (as used by Benavides), name applied to all or part of the people on the Rio Grande between La Juanta and El Paso, were one and the same, as descriptions of their culture indicate, and they were in reality various divisions of the Sumas who extended from below El Paso to La Juanta in 1683.

Piecing together the observations of various chroniclers, a picture of great flexibility in settlement organization emerges. Schroeder (1974:159) interprets descriptions of the Otomoacos subsistence-settlement organization to include permanent villages with chiefs, mud and wood houses, cultivation and fishing; other descriptions depict seasonal habitation of pithouses and other more ephemeral shelters. Lujan, a chronicler in the Espejo expedition of 1581-1583 described Patarabueyes or Otomoacos groups which correspond to those described later in the El Paso area:

> ...this rancheria [Otomoacos] resembled a pueblo as it was composed of flat-roofed houses half under and half above the ground...And all, both old and young, offered everyone maize, beans, mescal, dry calabashes, gourd vessels, buffalo skins and Turkish bows and arrows... Even though they live in the pueblos they have flat-roofed houses in their field where they reside during harvest time (Hammond and Rey 1929 pp.59-60).

About the rest of the trip to the Piro settlements, Lujan stated "During this entire trip we never met any people although we found many traces of them and many abandoned rancherias" (Bolton 1952).

In January of 1583, Espejo describes inhabitants of the Rio Grande (Bolton 1952:173):

> On the banks of this river (Rio Grande) Indians of this nation [which he called Jumanos or Pataragueyes] are settled for a distance of twelve days' journey. Some of them have flat-roofed houses, and others live in grass huts.

The place on the Rio Grande where the river forms a second channel during periods of overflow has been identified by Schroeder below El Paso. This location figures in Espejo's description of his journey north along the river in which he describes the people he encountered (Bolton 1952:175):

> These people, who must have numbered more than a thousand men and women, and who are settled in their rancherias and grass huts, came out receive us....Each one brought us his present of mesquital, which is made of a fruit like the carob bean [mesquite bean], fish of many kinds, which are very plentiful in those lagoons, and other kinds of their food...

Upstream from the lagoons, Espejo encountered a rancheria "of few people but containing many grass huts, many deer skins, also dressed like those they bring from Flanders, a quantity of very good and white salt, jerked venison, and other kinds of food (Bolton 1952 :175)" which appears to have been a seasonal reoccupation; the empty huts being remnants of past occupations. Schroeder points to the possibility that habitation along the Rio Grande was only during the winter since the Chumuscado expedition passing through earlier in the summer of 1581 did not encounter these people.

Alvar Nunez Cabeza de Vaca encountered groups who practiced part time agriculture farther to the south along the Rio Grande (Bandelier 1922:152):

> The country is well settled. We asked them why they did not raise maize, and they replied that they were afraid of losing the crops, since for two successive years it had not rained, and the seasons were so dry that the moles had eaten the corn, so that they did not dare to plant any more until it should have rained very hard.

The same groups are described as lacking ceramics and cooking beans and squash by method of stone boiling in a gourd. Farther along his route "some permanent houses, with plenty of harvested maize" were encountered;the houses were "made of earth, and others of cane matting" (Bandelier 1922:155-156).

Ethnographic Observations and Their Potential Archaeological Significance

If any one theme can be extracted from the above ethnographic and historical observations of basin and range groups, it is that patterns of group movement and composition for forager/collectors and agriculturalists are extremely flexible. Foraging and collecting activities commonly ascribed to hunters and gatherers provide substantial portions of the diet for some groups known to practice agriculture and are often carried out by these people with a high degree of planning depth. One reason for seasonal fluctuation in group size and mobility is reliance on plant resources in a region where harvesting periods are related to elevation -- earliest spring greens and seeds become available in the basins with later ripening seasons occurring at increasingly higher elevations. A second recurring attribute of the groups investigated here has to do with the reuse of places. Almost all groups surveyed were known to have "favorite spots" which were reused by families and smaller more task-specific groups in the course of an annual round. Reuse of specific places and general areas was manifest ethnographically as continuous distributions of camps and houses in favored areas.

Changing mobility patterns and group size on a seasonal basis seems to be the essence of adaptive success within the basin and range environments reviewed here. Rather than slow, periodic change through which groups progress from foragers to those practicing part-time and full-time agriculture, the ethnographic record of basin and range inhabitants documents very fast fluctuation between more and less "sedentary" adaptations, for the same group of people in the same area. From the above descriptions it appears that many groups may essentially have been "Mesilla-like" in their adaptation; that is, depending on foraged resources and agricultural products in an annual round characterized by some highly mobile periods.

Changing mobility patterns and the size of the mobile group relative to the plant productivity and its distribution over the landscape widens the array of resources available to a foraging group and lengthens the amount of time a locality will be able to sustain a single group. Large distances may be traversed by small groups, moves having great planning or tactical depth. Such groups, whether they are plant foragers or more specialized hunters, may be highly "geared up"; that is, they provision themselves with the implements necessary to carry out anticipated activities. Mobile groups may also take advantage of opportunistically encountered resources although no technological provisions were made for their procurement. This means that in terms of technology and labor pool, the same activity has the chance of being carried out in a number of different ways depending on whether or not it was anticipated.

The location and distribution of agricultural property likewise dictate patterns of group movement and community/camp size among agriculturalists, and the settlement strategies of a single group are quite complex when individual families or groups of families within a community resort to alternative land use patterns. By adjusting group mobility and size, agriculturalists are better able to share habitable space and agricultural property and to deploy required seasonal labor. Historical observation of the same people occupying semi-permanent villages or rancherias and peripheral fieldhouses at the same time compare with ethnographic accounts of alternative land-use strategies employed by the same group of people. Within the same community some families may live in relatively compact villages their houses taking up all the practicably habitable space near their fields, others may build field houses from which to deploy seasonal labor rather than travel from a main village, while others still will live in widely dispersed field houses during the growing season and in temporary winter camps during the rest of the year.

From the above ethnographic descriptions and discussion, one can see that functionally identical sites in different group size and mobility regimes are going to look very different. In other words, the same thing can be done a lot of different ways. Ultimately, this means that reconstruction of "site" function with archaeological remains is not possible nor perhaps a desirable goal of analyses. Functional reconstructions usually rely on segregation of archaeological materials on the bases of associated structures, features, and artifacts. If these can look different but actually represent functionally identical contexts as indicated by the ethnographic literature, then reconstructions based on direct inference from the contents of assemblages do not provide a reliable basis for reconstructing settlement systems. In addition to the same activity taking on different archaeological "poses", the settlement pattern of a single group may look very different in different ranges so that flexible settlement strategies run the risk of being interpreted archaeologically as alternative adaptations by different groups in separate but partially overlapping ranges.

Description of other resources besides those provided by foraging and agriculture are clues to logistical elements of settlement systems in south-central New Mexico. Resources such as fish may have contributed as much to the diet of some seasonal riverine inhabitants of basin and range country as rabbits and deer (Spier 1933:73). Historical observations of those traveling along the Rio Grande mention "cow" and deer hides indicating that hunting also contributed to the diet of El Paso area groups. Given a wide logistical radius around seasonal and relatively permanent home bases, planned technologies and deployment of special task groups would have figured to some degree in all subsistence-settlement strategies.

Fishing as described for the Pima, Maricopa, and Papago may have been a year round pursuit but may have been carried out with several different mobility strategies. These strategies include casual fishing undertaken from residences and fishing expeditions which camped in areas where there where no permanent settlements (Spier 1933:18). From descriptions of the nets and other tackle used in various methods employed for fishing, it is clear that substantial investment in gear, especially in large nets, was required for some methods and that deploying the necessary labor force and proper technology required some planning depth. Bradley (1983:91-97) suggests that fishing in the Rio Grande may have been a seasonal activity and techniques probably involved netting or seining operations and possibly fish stupafication. Members of the catfish, gar, and sucker families are well represented in the bone and scale fragments recovered from La Cabrana, a 14th century pueblo on the Rio Grande at El Paso.

Planning and gearing up for short and long distance hunting trips is another potential alternative for inhabitants of the El Paso area. The presence of deer and mountain sheep remains at La Cueva in the Organ Mountains (Lehmer 1948; O'Laughlin 1965) and White Rock Cave in the Franklin Mountains (Bice and Phillips 1967; Green 1971) attest to this possibility. The jerked venison and "deer skins" described by Espejo are indications that the annual round of seasonal inhabitants of the Rio Grande valley were involved in such pursuits. Organized buffalo hunts by mobile hunter-gatherers and puebloan groups are described ethnographically (Basehart 1983:10; Sando 1979:426). Mescalero groups with geographical centers in the mountains undertook lengthy "migrations and more extensive preparation than needed for the pursuit of deer or antelope" in order to hunt buffalo on the eastern plains of New Mexico (Basehart 1983:154). Bison bone has been recovered from three Pueblo period villages in the Sacramentos (Whalen 1980:432) and although none is known from prehistoric occupations in the south-central basins of New Mexico the long distance transport of"cow hides" described by early travelers along the Rio Grande may have been linked with transport of jerked meat as well.

Seasonal reuse of places appears to be the norm not the exception in an annual round. Camping places near water sources, winter and summer villages, mesquite, mescal, and cactus collecting and fishing camps are cited as places that are heavily reused by agricultural groups. Likewise, areas around water sources, winter base camps and summer camping areas were targeted for reuse by more mobile groups. Espejo's account of a rancheria with few people but containing many grass huts could well be an example of such a reused camp.

What would a single Mescalero or Maricopa winter camp or village look like archaeologically? Chances are it would be "discovered" as a series of tiny camps (if surveyed with great enough intensity) to use Whalen's terminology with some of the camps being relegated to the status of "isolated artifacts." In areas subject to heavy reuse over the long-term, amalgams of residential and special purpose debris accumulated over generations that occurs in continuous but uneven distributions are much more "discoverable" archaeologically. Due to their size and content (presence of trash middens, etc.), these archaeological composites would qualify for hamlet or village status while they actually result from numerous occupations.

Some portions of these amalgams such as those associated with architecture are going to be more visible archaeologically than others running the risk of classification as functionally distinct single occupations. Areas used repeatedly as residences over the long-term are likely to contain amalgams of residences and other occupations, as well. Movement of the residential base whether by hunter/gatherers or by agriculturalists after a single or several generations will place the former residence in a foraging or logistical zone of exploitation where items are added (or subtracted) but form a less visible component of the assemblage than do the residential structures. With systematic group movement it is not surprising that such composite assemblages are replicated in many places probably forming a majority of the basic unit of discovery and analysis, the "site". Such may be the case along alluvial fans bordering the Hueco Bolson and Tularosa Basin. Repeatedly used processing locations and seasonal residences in the Mesilla Bolson may punctuate a light but continuous distribution of debris in this area as well, but may have been deposited during foraging and short-term residential occupation, the latter recognized as "sites" and the former as a low density surface distribution. Successful application of a survey technique that seeks to identify sites and isolated artifacts is difficult if not impossible in this context.

CHAPTER 4

ARCHAEOLOGICAL RECONNAISSANCE AND DISTRIBUTIONAL SURVEY FOR THE NAVAJO-HOPI LAND EXCHANGE PROJECT IN NEW MEXICO

Chapter 4 reviews the two phase survey design of the Navajo-Hopi Land Exchange Project (NHLEP). During Phase I of the distributional survey, the entire survey area was gridded into 400 x 400 and 800 x 800 meter survey units. Gridding established the control for a systematic survey and was also indispensable for locating survey units on a reticulate mesquite-anchored dunescape lacking recognizable landmarks. During Phase I, preestablished transects were walked in each unit for purposes of obtaining information concerning surface artifact densities. In addition, surface manifestations of buried structures and features were evaluated with a program of subsurface testing.

Phase I density information was then used to stratify survey units into groups with surface distributions of artifacts and features comparable in terms of density and content from which a Phase II survey sample was selected. Phase II distributional survey procedures involve the intensive recording of 4.48 square kilometers in sampled portions of Survey Areas 1, 2, and 3. Inventoried artifacts and features in sampled survey units are documented and surface distributions in these units are described in the second half of Chapter 4. Phases I and II survey results are then compared to survey data gained through conventional techniques demonstrating the utility of a distributional approach.

PREVIOUS WORK IN THE NAVAHO-HOPI LAND EXCHANGE AREA

by Signa L. Larralde

The search for previously recorded cultural resources in the study area encompasses lands on the U. S. Geological Survey Smeltertown, Strauss, and La Union 7.5-minute quadrangles and a 2-mile wide north-south strip of area along the eastern border of the Noria 15-minute quadrangle. Files, maps, and reports were reviewed at the Bureau of Land Management (BLM) Las Cruces District Office, at the Laboratory of Anthropology in Santa Fe, at the laboratory of the El Paso Archaeological Society, and at the El Paso Centennial Museum, University of Texas at El Paso. Archaeologists familiar with the area were consulted for advice and for information about local archaeological surveys and excavations. These included Patrick Beckett of the Arizona State Museum; Thomas O'Laughlin, Curator of Anthropology at the El Paso Centennial Museum; John Ravesloot of the Arizona State Museum; Robert Hard and Vernon Scarborough of Fort Bliss Archaeological Program; and David Batcho and David Carmichael of the Cultural Resources Management Division at New Mexico State University.

Previous surveys in the project area consists largely of seismic line clearances, along with one sample survey, and two block surveys (Figure 4.1). The seismic lines can be construed as random transects across the West Mesa. Both the sample survey and the block survey were located at the edge of the Rio Grande escarpment and both take in portions of the West Mesa interior as well as O'Laughlin's (1980) Leeward Slope Zone. Additionally, several excavation reports, for large El Paso Phase pueblos and earlier complexes of pit structures, document cultural resources in the Riverine, Leeward Slope, and Lower Bajada Zones on both sides of the Rio Grande. In all, these projects allow an assessment of the nature and extent of cultural resources likely to be found on the West Mesa.

Two points stand out from the literature review. First, when one moves westward approximately 2 miles from the West Mesa scarp, sites appear to be quite redundant in size and content. With very few exceptions, the longest dimension of sites rarely exceeds 100 meters. Sites generally consist of a combination of fire cracked rock scatters, brownware ceramics, mano and metate fragments, and chipped stone debris. In contrast, scarp edge and riverine sites cover much larger areas, contain evidence of adobe masonry and pit structures, and high densities of artifactual material including highly diverse ceramic assemblages.

The lack of variability for interior basin sites is undoubtedly partially a function of the second point: the standards for recording cultural resources in this area, as for most other areas, are variable, and in the absence of a regional research design no systematic data collection strategy links project methodologies. Often,

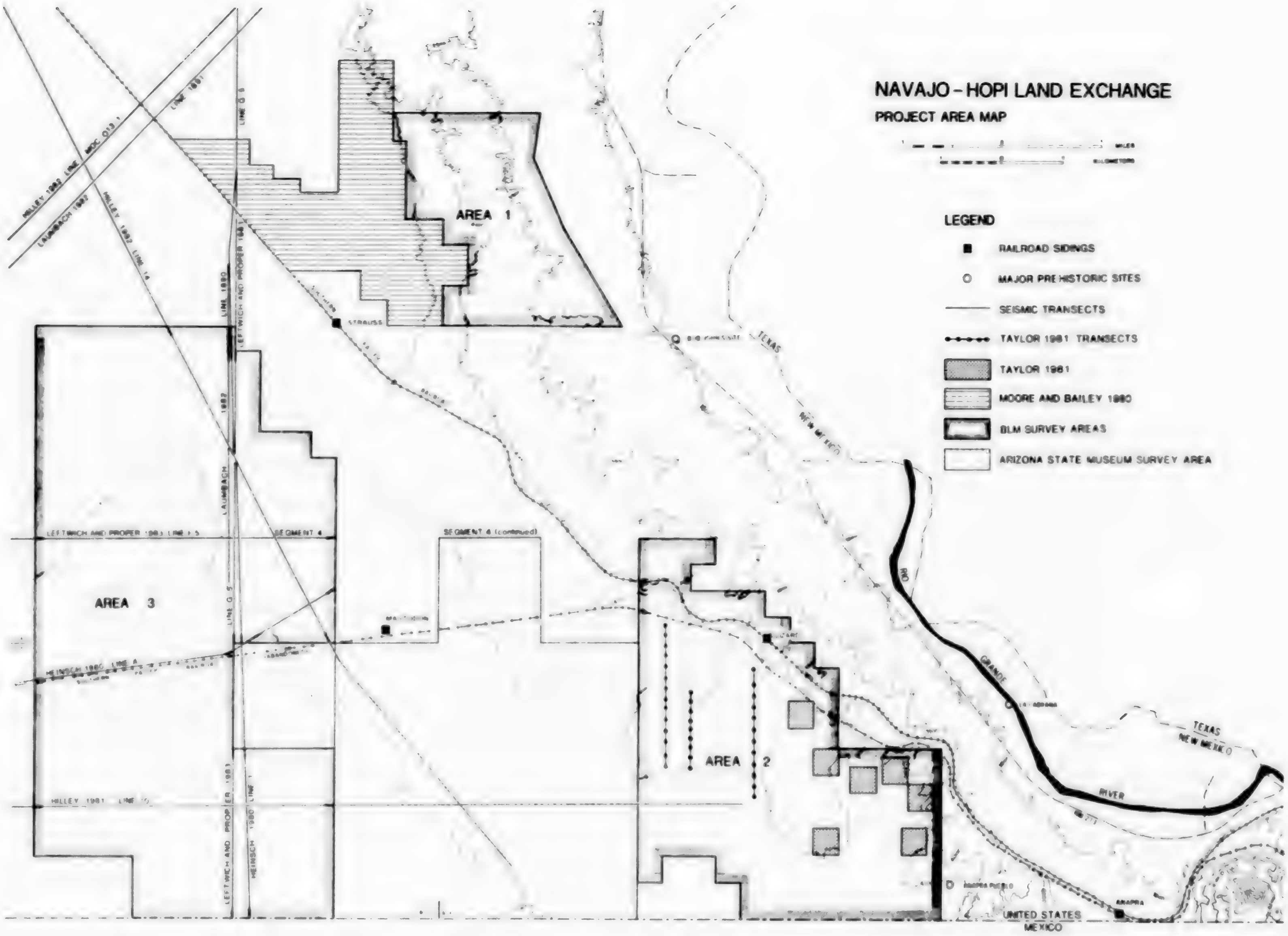


FIGURE 4.1.

PREVIOUS ARCHAEOLOGICAL PROJECTS IN THE LAND EXCHANGE AREA.

project standards for recording sites and isolates are internally inconsistent. In most other cases, either site/isolate definitions are not explicit or the line between them is so fuzzy as to render the definitions meaningless.

Two conditions are responsible for these recording problems: (1) there is, in fact, no difference between "SITES" and isolates, boundaries are entirely arbitrary and are largely a result of depositional factors rather than cultural ones; and (2) a debris scatter that varies in density blankets the entire area. While previous work represents a "good faith" effort on the part of competent archaeologists, given variable site definitions, "sites" recorded on different projects are not comparable in area, item frequency, or content, and isolate and locality records must be consulted if one is to formulate an accurate picture of the archaeology of the West Mesa. The problem with isolate and locality records is that their information content is almost always minimal compared to site records. Historic debris is also differentially recorded, and disparities in recording procedures are probably responsible for the very low occurrence of historic items on some projects, e.g. Heinsch (1980) versus the higher density of items found on others, e.g. Hilley (1981). These quandaries in data collection and reportage bespeak a need for changes in survey methodology -- alternatives to obtaining site and isolate data with little information content, especially when these data may not accurately reflect the nature of the surface archaeology in an area, must be sought.

PHASE I SURVEY

The cultural resources survey of the NHLEP was organized in two phases. The Phase I survey was designed to inventory artifact and feature densities for the entire area of the land exchange in a relatively expedient manner. All portions of the exchange area were walked and inventoried by tallying artifacts and features observed along survey transects in 40-acre and 160-acre parcels. The Phase I survey results consisting of systematically obtained artifact and feature counts for each survey unit provide reliable estimates of the content and density of artifact distributions in the entire exchange area. These transect data formed the basis for identifying areas that required further evaluation in the form of limited subsurface testing and for a stratified sample of Phase I survey units selected for more intensive investigation during Phase II. The Phase II survey was structures to document the surface archaeology of a selected sample of the exchange area and was followed by excavation of surface-visible features. The following section describes Phase I survey methods and the results of the survey. Phase II general survey results are then discussed.

Phase I Survey Procedures

The Phase I survey was geared primarily toward determining which areas were not suitable for an intensive documentation of their surface archaeology as a mitigation procedure. Such areas are characterized by high densities of surface artifacts and by evidence of subsurface structural remains both of which would have required a considerable investment in time and personnel to properly investigate. Areas identified as suitable for an intensive Phase II survey were those exhibiting low-to-moderately dense surface distributions. Given the extremely short timeframe for location and mitigation of cultural resources in the exchange area, an intensive Phase II surface documentation of artifact and surface-visible features is more easily managed in this latter context. Analysis of Phase I survey data delineates those project lands containing archaeological surface and subsurface materials better examined through a program of intensive surface documentation, subsurface testing, and careful excavation subsequent to the Phase II survey.

The Phase I transect survey was undertaken in three separate survey areas: Areas 1, 2, and 3 (Table 4.1). Transects were spaced at 25 meter intervals on the mesa top in Areas 1 and 2 for two reasons. Relatively dense distributions of surface material and subsurface structural remains were expected prior to survey; and, it was felt that given the time constraints for obtaining Phase I survey results with 25 meter spacing would be as likely to encounter major midden deposits associated with prehistoric residential use of areas as a closer spacing interval. This procedure yielded quantitative data in the form of artifact and feature counts for 16 (25 meter spacing) parallel 2 x 400 meter transects walked in each 400 x 400 meter survey

Table 4.1. Area (hectares/acres) and transecting methods by survey area.

Topography	Mesa top	Breaks	Mesa top
Transect Interval	25m	50m	50m
Survey Unit Size (m)	400x400	400x400	800x800
Area 1	111/273	572/1,413	
Area 2	1,448/3,579	430/1,062	
Area 3			3,749/9,264
TOTALS	1,559/3,852	1,002/2,475	3,749/9,264

unit on the mesa top (Figures 4.2a and 4.2b). In the areas of ridges and breaks in the Leeward Slope Zone where low density surface distributions of archaeological remains were encountered, transects were spaced 50 meters apart. Survey units walked at 50 meter intervals also consist of 400 x 400 meter grids, unit size being consistent with units which were walked at 25 meter intervals on the mesa top. Artifact and feature tallies were obtained for 8 (50 meter spacing) transects in these survey units. Both a 25 and a 50 meter interval was used in some Area 1 and 2 units straddling the West Mesa scarp. This caused a number of the transects walked to vary from that of units in which a standard 25 or 50 meter spacing was employed.

Survey of Area 3 utilized 50 meter transect spacing in 800 x 800 meter survey units (Figure 4.2c). Logistical considerations which included problems of access and the short timeframe slated for Phase I survey precluded greater spatial control in Area 3. Sixteen 2 x 800 meter transects were walked in each Area 3 survey unit.

In addition, some survey units in Area 2 containing previously recorded structural remains were deemed appropriate prior to the Phase I survey for more intensive investigation than would be undertaken during the later Phase II portion of this project and were not walked. These are survey units 46, 47, 54, and 55 containing Worley Pueblo and survey units 94 and 95 which include another pueblo documented by Taylor (1980) during his survey of the mesa top (see Figure 4.1). Survey unit 113 in Area 2 where Anapra Pueblo is located was walked in order to document the cultural remains present within a trespass dump located on the mesa edge and the extent of mechanical damage to these remains.

Phase I survey methods were geared towards obtaining quantitative data with which to compare survey units, and general categories of artifacts and features were used to simplify the inventory process. Transect artifact inventories include five major categories of items: ceramics, chipped stone, groundstone, features, and historic artifacts (Appendix D). For purposes of rapid recording during the Phase I survey, ceramics were broken down into five subsets. These are plain brownwares, El Paso Bichrome and Polychrome, Chupadero Black-on-White, Mimbres Black-on-White and "Other". The first four ceramic categories are those which were expected to occur most frequently in the study area. Other decorated types documented for the area which occur in low frequencies were recorded with the "Other" category. Chipped stone artifacts were recorded in two categories: informal and formal. Informal chipped stone includes flakes, cores, and angular debris. Formal tools include all those items flaked on over one-third of one or more faces encompassing bifaces, unifaces, and projectile points. Projectile points were also

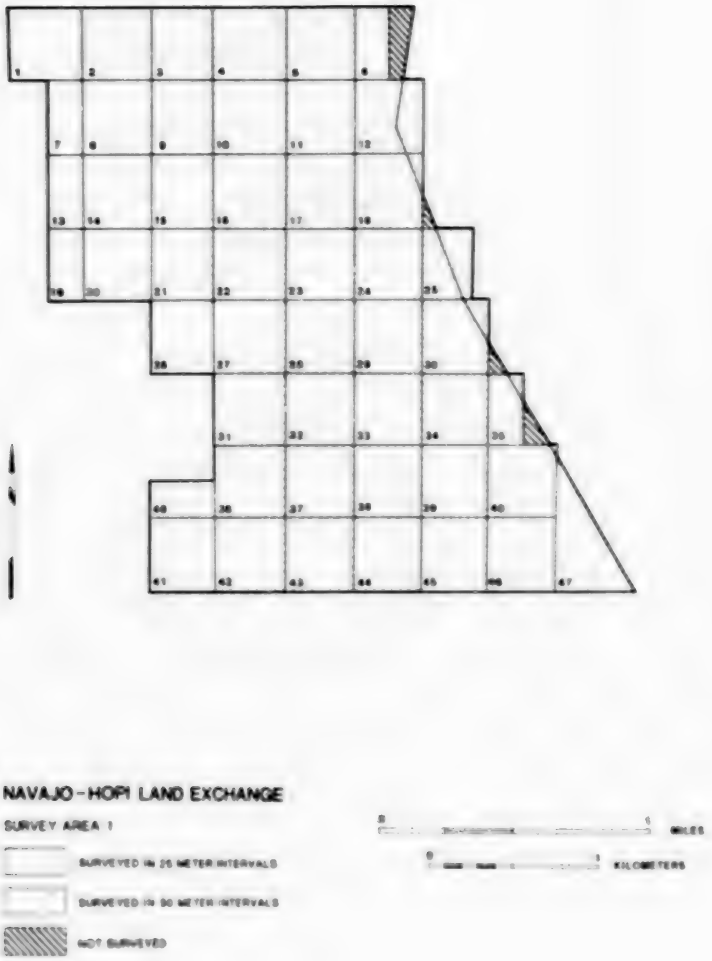


FIGURE 4.2A.
SURVEY AREA 1.

83

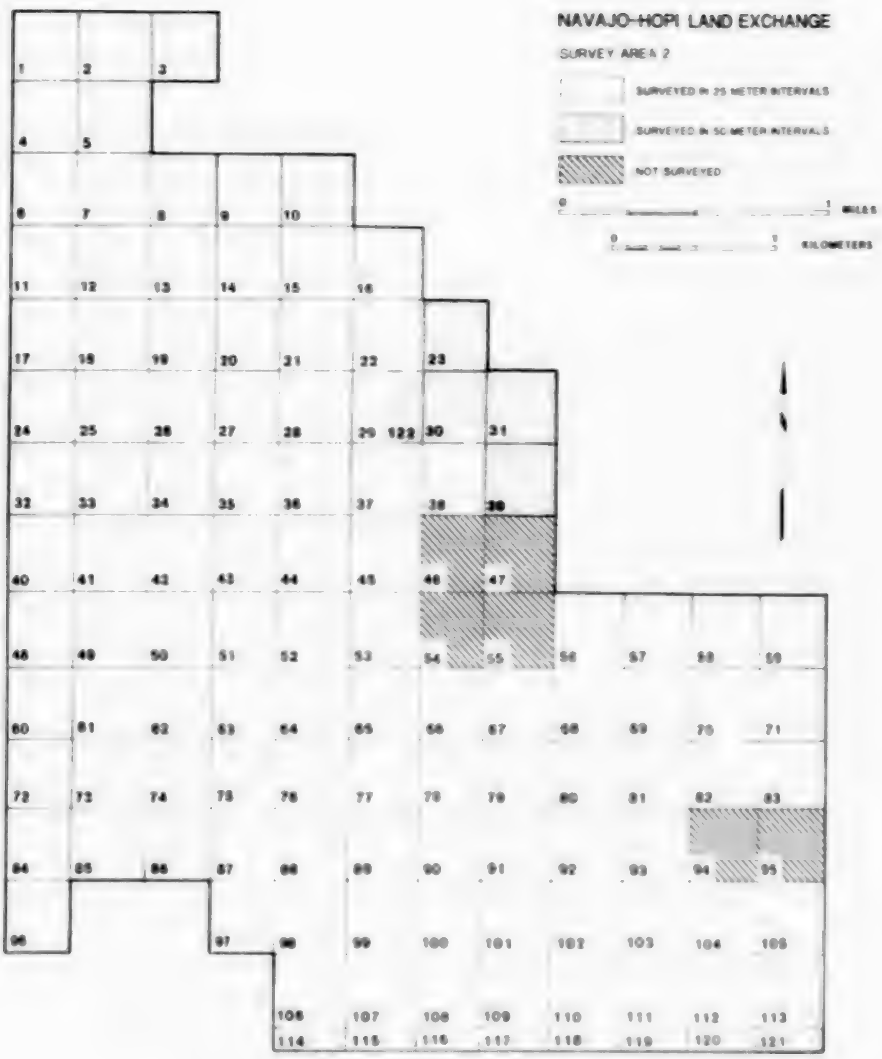


FIGURE 4.2B.
SURVEY AREA 2.

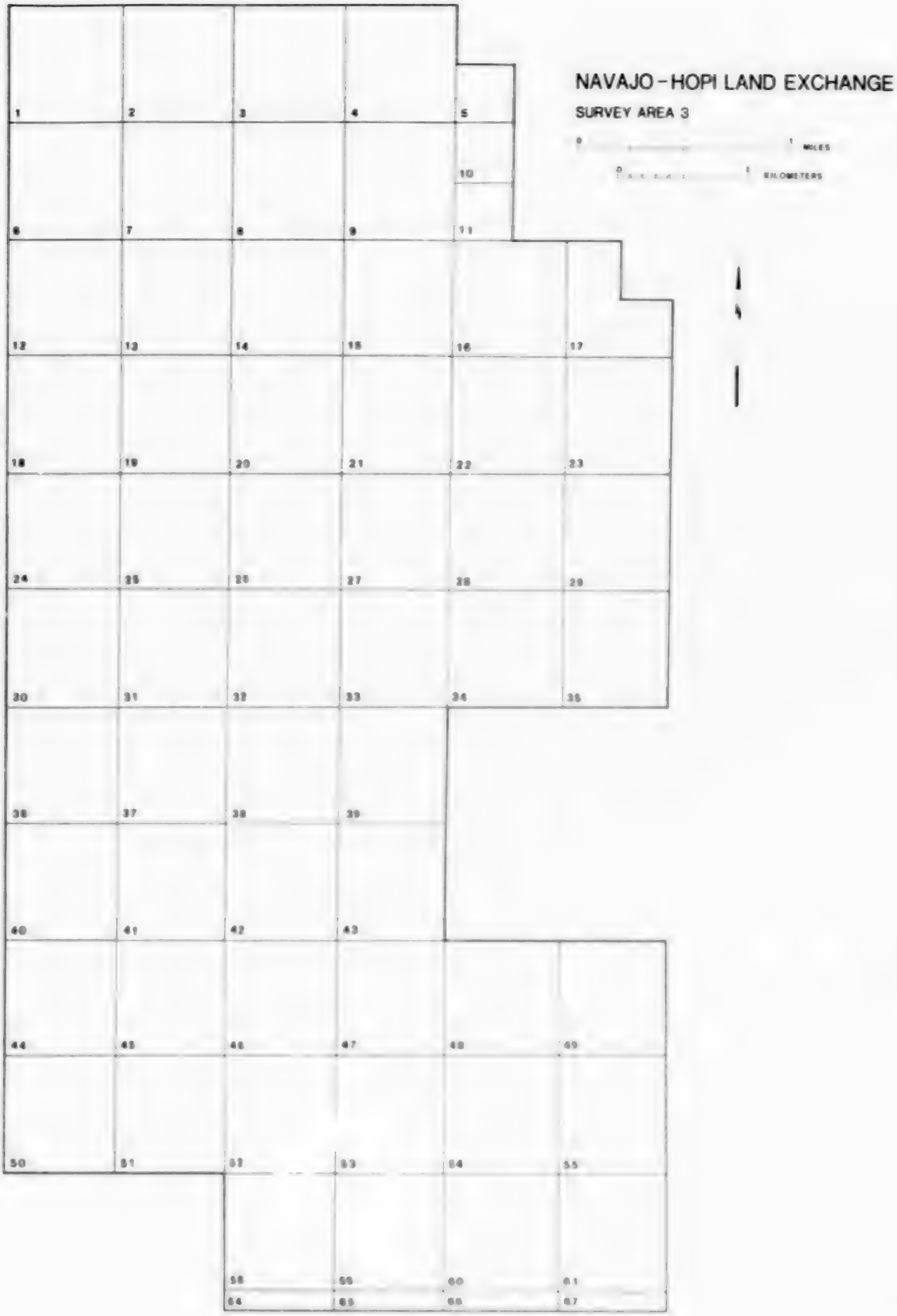


FIGURE 4.2C.

SURVEY AREA 3.

outlined and described. Groundstone tools include manos, metates, hammerstones, and an indeterminate fragment category. Surface features are limited to (1) mounded accumulations of fire-cracked rock (FCR), or fire-altered rock (FAR) that is for the most part quarried caliche, (2) disarticulated FAR accumulations, (3) formal or intact hearths consisting of a circular or oval outline of cobbles, burned caliche, or artifacts, and (4) surficial ashy soil indicative of buried features. Isolated or single pieces of FAR were also tallied. The only historic artifacts routinely tallied were hole-in-top cans and purple glass. Modern trash deposits were noted but the materials in these were not tallied.

In addition to quantitative data in the form of transect artifact tallies, notes were taken in each survey unit (Appendix E) describing:

1. the overall artifact/feature density on the survey unit;

2. the nature of observed artifact distributions (e.g. dispersed scatters, artifact/feature concentrations, etc.);

3. the presence of intact features (midden deposits, hearths, discrete burned caliche concentrations, etc.);

4. the variety of artifactual remains present in survey unit tallies as well as at particular locations noted on tally forms; and

5. the degree of mechanical disturbance suffered by the surface of the survey unit.

Artifact concentrations were noted on topographic maps when encountered on transects in order to allow further evaluation of these areas for the presence of subsurface structures.

Phase I Survey Results

The number of survey units transected with Phase I survey methods is listed in Table 4.2. The inventory of survey units in Appendix E lists survey unit legal descriptions, size, number of linear transect meters walked, the date of survey, and survey crew chief. A survey unit size of less than 16 hectares indicates partial units in Areas 1 and 2 while partial units in Area 3 measure less than 64 hectares.

Table 4.2. Size and distribution of survey units.

Survey Area	Number of Surveyed Survey Units*	Survey Unit Size (hectares)
1	48	16
2	116	16
3	62	64

Note: *includes partial survey units on project area boundary

One of the principal goals of the Phase I survey was to identify areas for which mitigation through Phase II recording procedures would be less than complete. It was anticipated, and survey results confirmed, that most of the proposed exchange lands are characterized by a diffuse, low density artifact scatter resting on or very near a 200,000 year old paleosol. However, previous archaeological work has shown that more complex, long-term residential areas do exist in this area. Known examples include Anapra Pueblo, Worley Pueblo, and an El Paso Phase pithouse recently excavated by New Mexico State University (Batcho et al. 1985). These situations are recognized by high artifact densities, by a larger variety of artifacts, by actual structural remains such as adobe mounds, by ash stained midden deposits, and by multiple ash filled extramural features. Phase I survey units yielding moderate and high densities of artifacts were systematically reexamined by testing crews for the presence of subsurface features. Results of limited subsurface testing using a soil probe and surface troweling to detect and uncover buried features are listed in Appendix C.

Phase I survey data consist principally of item counts summarized by transect and by survey unit. Since transect interval and survey unit size varied among units, counts are not comparable unless standardized by some independent measure. In order to standardize Phase I survey unit counts, the number of artifacts and features tallied in each unit was divided by the number of linear transect meters (LTMs) walked in each unit. Since LTM is considerably larger than number of artifacts and features tallied, artifact and feature counts were divided by number of thousand LTMs

Table 4.3. Total artifact and feature counts in each survey area.

Area	Ceramics	Lithics	Ground-stone	FCR Isolates	FCR Scatters	Other Features	Historic	Totals
1	290	193	20	165	83	1	182	934
2	4,030	3,650	917	770	288	7	2,223	11,885
3	741	1,059	454	660	361	11	33	3,319

Table 4.4. Artifact and feature counts standardized by LTMs for survey areas. Counts are given per 1,000 LTMs, or 2,000 square meters.

Area	Total LTM	Ceramics	Lithics	Ground-stone	FCR Isolates	FCR Scatters	Other Features	Historic	Totals
1	170.45	1.70	1.13	.12	.97	.48	.01	1.07	5.48
2	682.56	5.90	5.35	1.34	1.13	.42	.01	3.26	17.41
3	731.20	1.01	1.45	.62	.90	.49	.02	.052	4.54

(LTMs/1000) walked in each unit to obtain comparable unit counts. For example, the number of thousand LTMs in a 400 x 400 survey unit transected at 25 meter intervals is 6.40. The count for survey unit 1 in Area 1 is 15 and the standardized count is 2.34 (15/6.40).

The variable number of transects walked and frequencies of LTMs walked in Survey Area 1 reflects adjustment of transects spacing to a badland topography. Phase I survey proceeded rapidly with from 2 to 7 units walked a day by a single crew of four in Survey Areas 1 and 2 depending on weather conditions, topography, and surface artifact densities. From 1 to 3 larger units in Area 3, situated farther from the West Mesa scarp, were walked with the same-sized crew.

Table 4.3 lists actual chipped stone, ceramic, groundstone, and historic artifact counts recorded in each survey area. Artifact counts standardized by the number of 1,000 LTMs are given in Table 4.4. (A thousand LTMs correspond to 2,000 square meters or an area of about 45 X 45 meters.) Standardized artifact counts are illustrated in Figure 4.3. Several high density distributions mark a generally low-density landscape in Area 1, while in comparison, Area 2 is distinguished by numerous, continuous high density survey units. Most survey units in Area

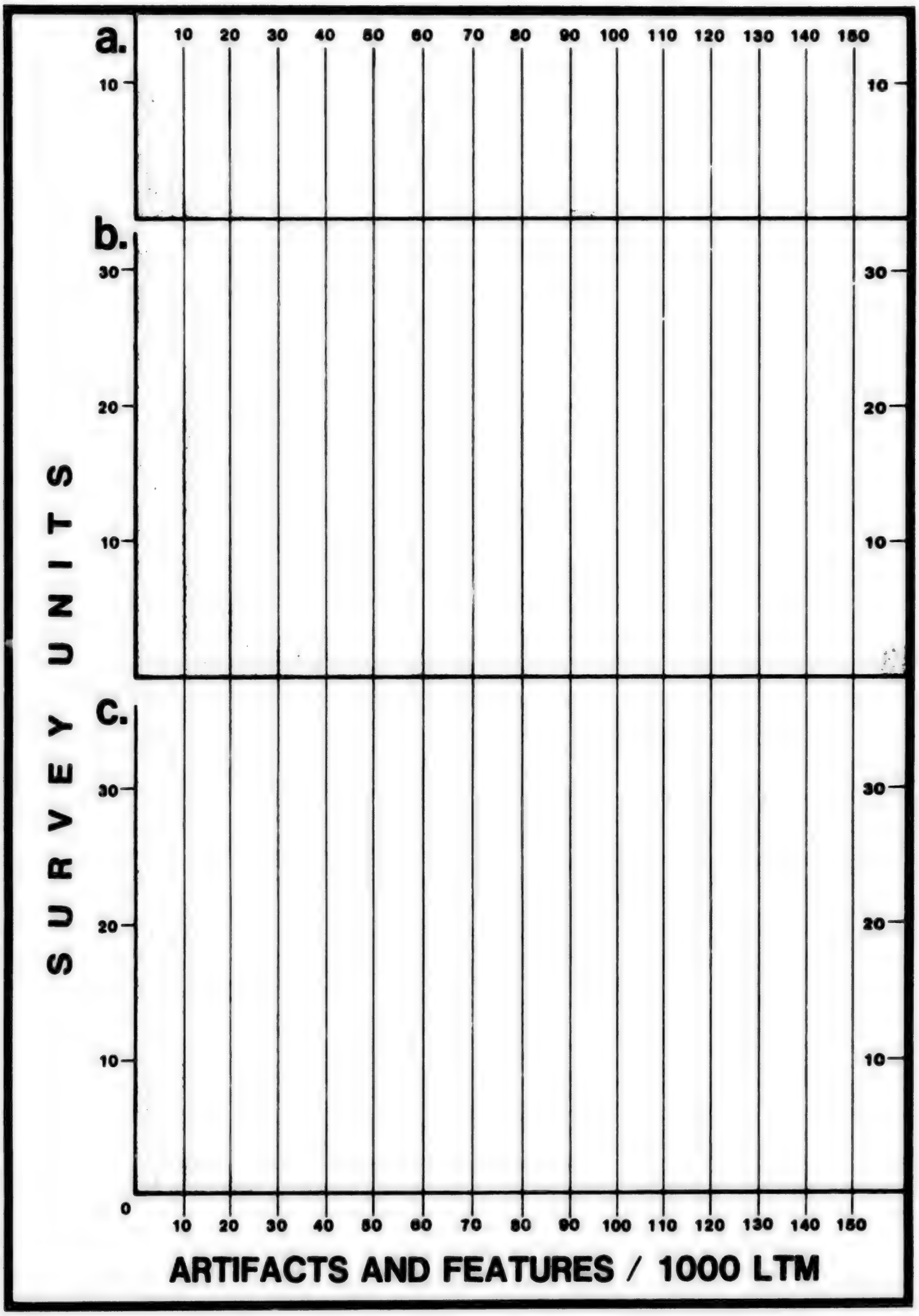


FIGURE 4.3.

STANDARDIZED ARTIFACT COUNTS IN SURVEY UNITS:

A. SURVEY AREA 1, B. SURVEY AREA 2, C. SURVEY AREA 3.

3 fall into a low-density category of less than 20 items per 1,000 LTMs, or .01 artifacts per square meter.

On the average, chipped stone and groundstone densities are lowest in Survey Area 1, while FAR scatters and other features occur in similar densities among survey areas. Dense, concentrated scatters of ceramics in an ashy sand matrix contribute to higher artifact densities in Area 2 and are interpreted as midden deposits. The structures which may be associated with such deposits are not routinely encountered during surface survey since their visibility is almost always obscured by modern sand cover. Other surface features in the form of cobble-lined hearths and mounded FAR accumulations, though present in Survey Area 2, are not as densely distributed as in Areas 1 and 3. Chipped stone densities equal those of ceramics in Area 2 and groundstone densities are also high. Area 3, in contrast, is a relatively low-density surface which contains more lithic than ceramic material and higher overall densities of FAR features and ash-stained surfaces, the manifestations of buried pits and pit structures.

Artifact densities were mapped (Figure 4.4a-e) for each survey area. Contour interval on these maps was calculated using a 400 x 400 meter grid. Area 1 with the fewest number of units contains proportionally the most low density units. This finding is understandable since the majority of this survey area covers the eroded slopes and ridges of gravel-laden Pleistocene sediments. Surfaces in these areas have been subjected to aeolian scouring that has exposed artifact distributions in a Pleistocene gravel matrix subsequently affected by water action. Survey Area 2 with a smaller amount of area below the West Mesa scarp contains survey units with the highest densities. Densities in most units in this Area 2 range between 5 and 85 items per 1,000 LTMs, 15 units containing over 25 items per 1,000 LTMs. With the exception of Unit 3 with a Phase I density of 35 items per 1,000 LTMs, densities of all survey units in Area 3 fall below 25 items per 1,000 LTMs.

In summary, the findings of the Phase I survey indicate low archaeological densities in the Leeward Slope Zone relative to those encountered on the West Mesa Surface. Densities vary over this surface between Survey Area 2 situated on the West Mesa scarp and Survey Area 3 located several miles from the scarp at its nearest point, increasing as one moves closer to the scarp. The content of archaeological distributions also varies, dominated in surface distributions nearer the scarp by ceramics and chipped stone and on the interior West Mesa Surface by chipped stone, groundstone, and FAR scatters. Surficial ash-stains indicative of relatively small features appear to be more numerous in Area 3. In addition, individual unit counts indicate that localized high densities are most prevalent in Survey Area 2, many of these corresponding to dense midden-like concentrations of artifacts, primarily ceramics, mixed with ashy soil.

An initial comparison of archaeological densities and topography within the project area shows that variation in surface densities across the landscape may be strongly related to topographic differences and that higher archaeological visibility may be directly linked with elevated areas and slopes exposed to the prevailing direction of spring winds. These relationships can be seen by comparing archaeological surface densities depicted in Figures 4.4a-e with topographic contours in Figure 4.5.

At the scale depicted here, contour maps of archaeological densities on the West Mesa Surface are analogous to a smoothed model of the topography. Archaeological surface densities are quite low, however, ranging from 1 item to about 20 items per 1,000 LTMs in Area 3 and from 1 to 154 items per 1,000 LTMs in Area 2. Topographic variability is also quite subtle, differences in elevation between depressions and adjacent rises rarely exceed about 8 meters over distances of at least 600 meters. However, though differences in item density and landform are subtle, a correspondence between the two appear in numerous survey units.

Within Area 3, the largest continuous area surveyed during Phase I, there are a number of striking correspondences between densities and landform. Highest archaeological densities in Area 3 are located on the "ridge" occupying the northern edge of the survey area (see Figures 4.4 and 4.5 for artifact densities and topography), the highest elevated landform in this survey area. Gains in density also correspond to elevated rises on the east and west sides of a

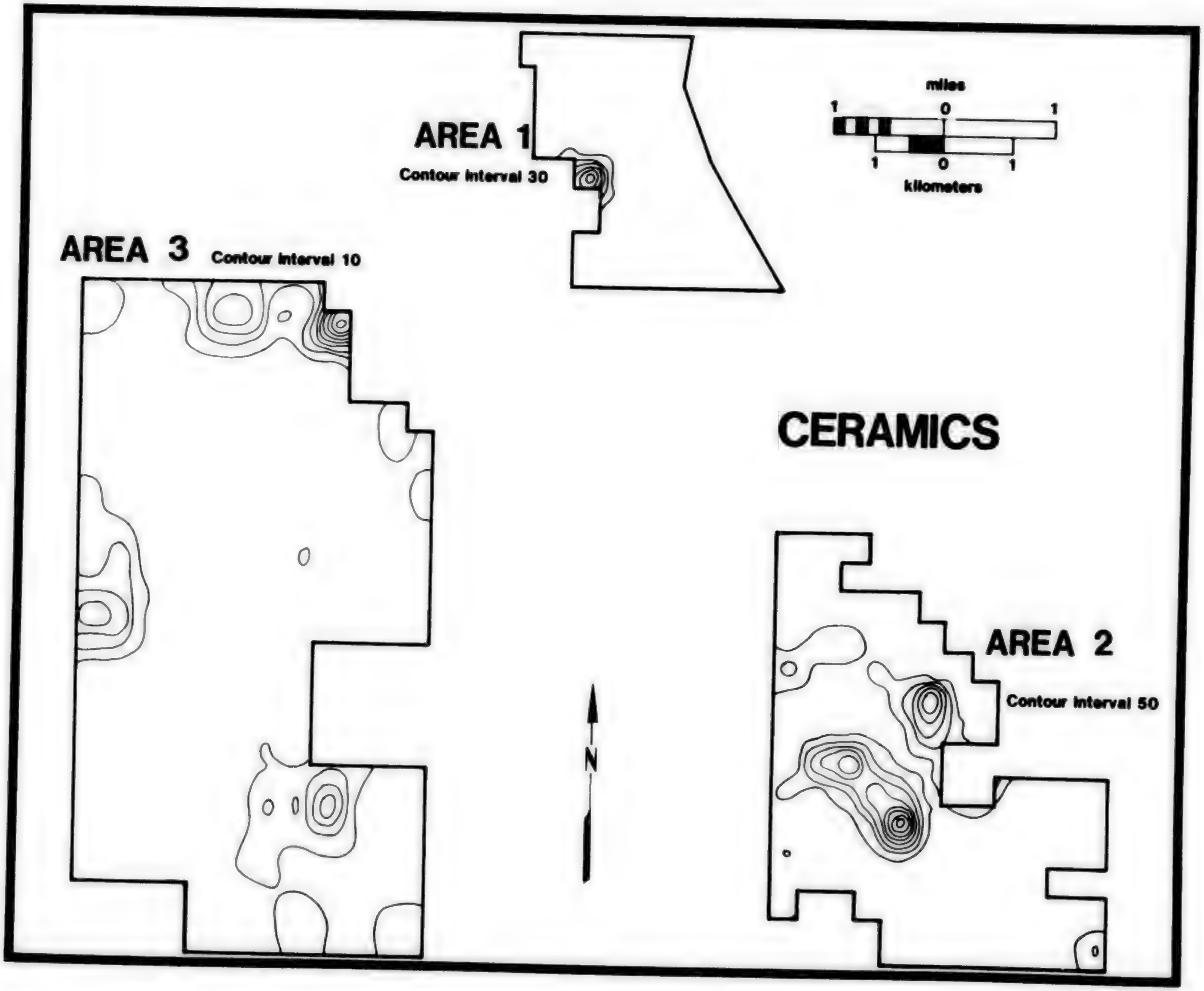


FIGURE 4.4.A
SURFICIAL CERAMIC ARTIFACT DENSITIES IN SURVEY AREAS.

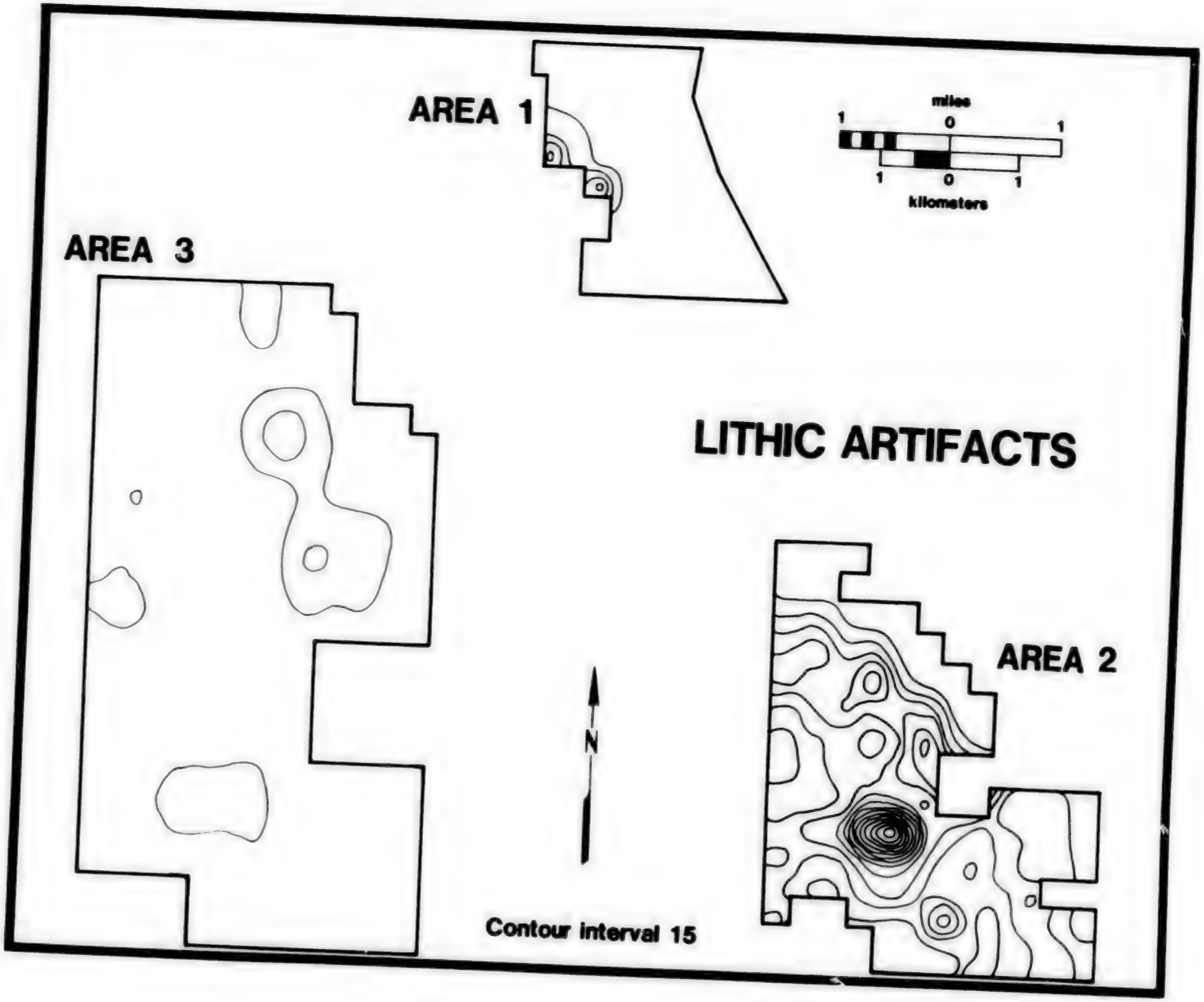


FIGURE 4.4B.
SURFICIAL LITHIC ARTIFACT DENSITIES IN SURVEY AREAS.

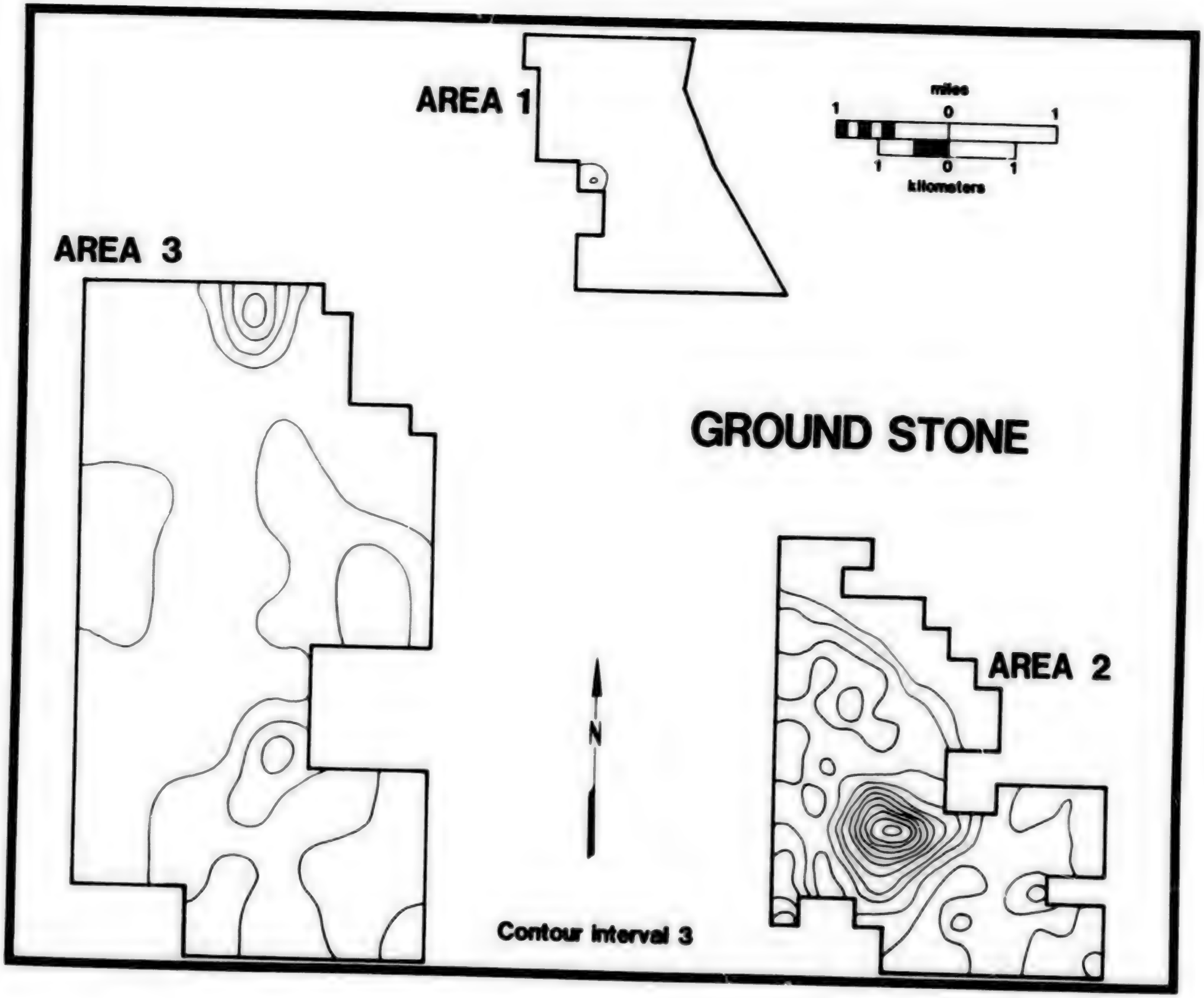


FIGURE 4.4C.
SURFICIAL GROUND STONE ARTIFACT DENSITIES IN SURVEY AREAS.

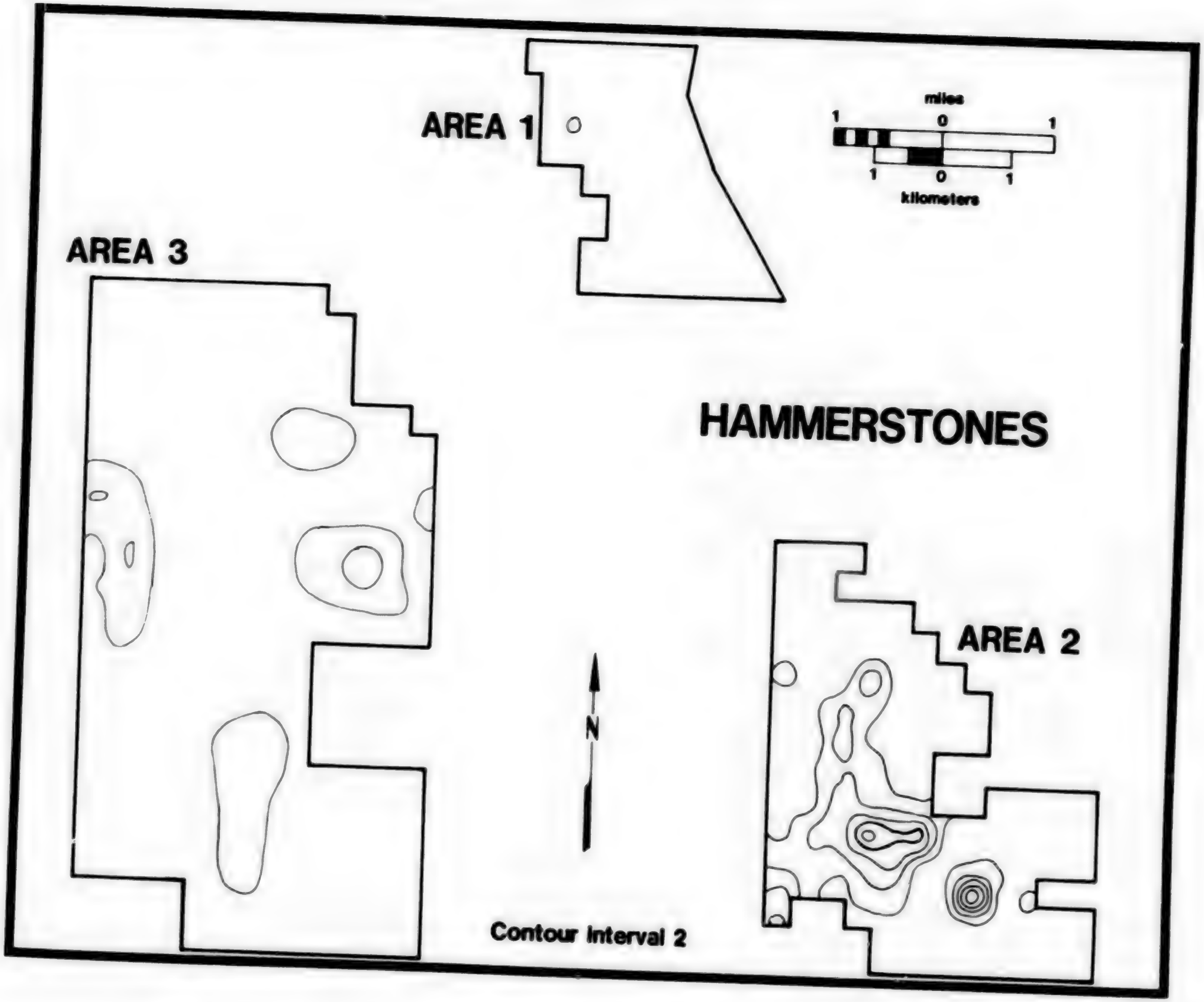


FIGURE 4.4D.
SURFICIAL HAMMERSTONE DENSITIES IN SURVEY AREAS.

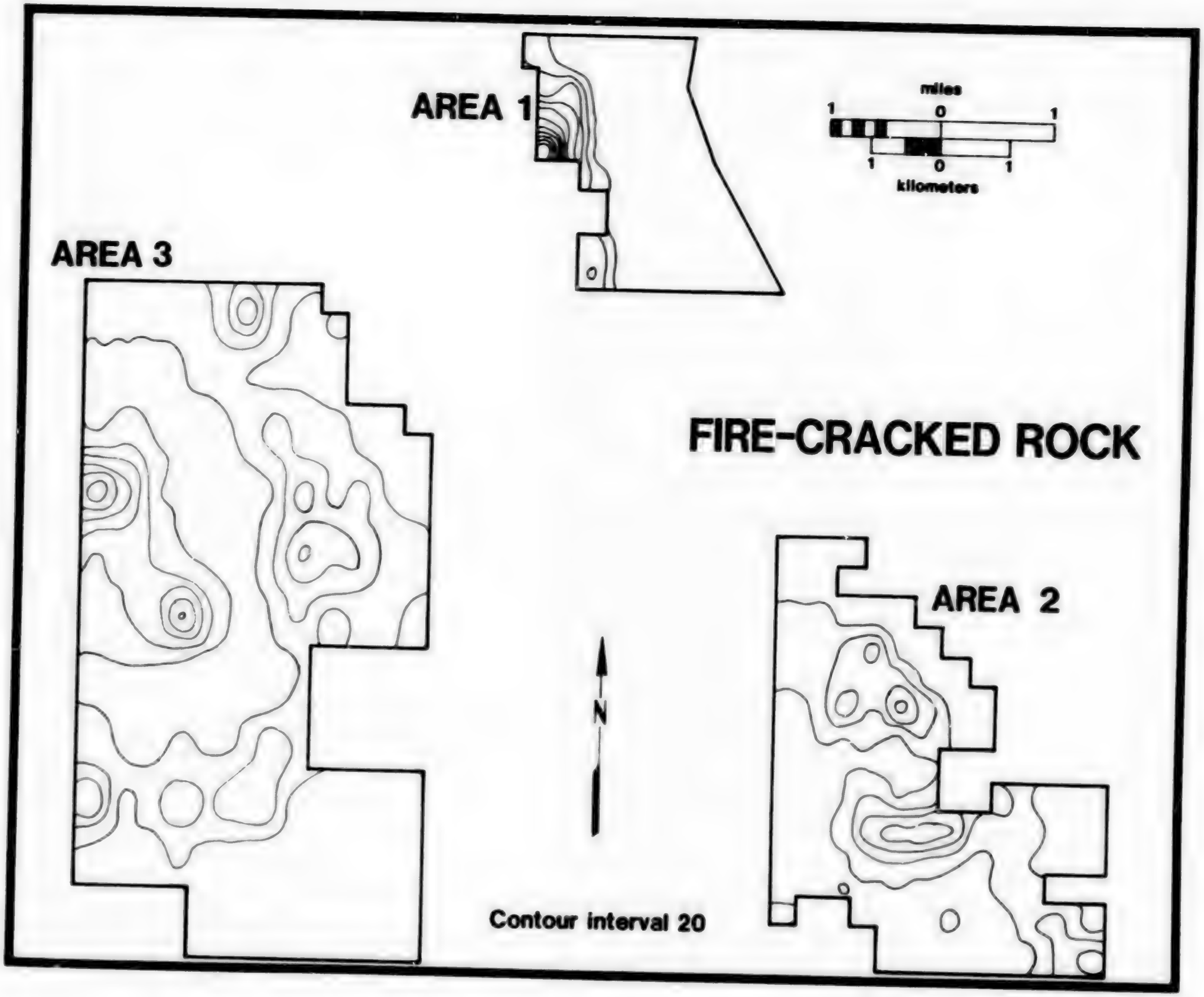


FIGURE 4.4E.
SURFICIAL FIRE-CRACKED ROCK DENSITIES IN SURVEY AREAS.

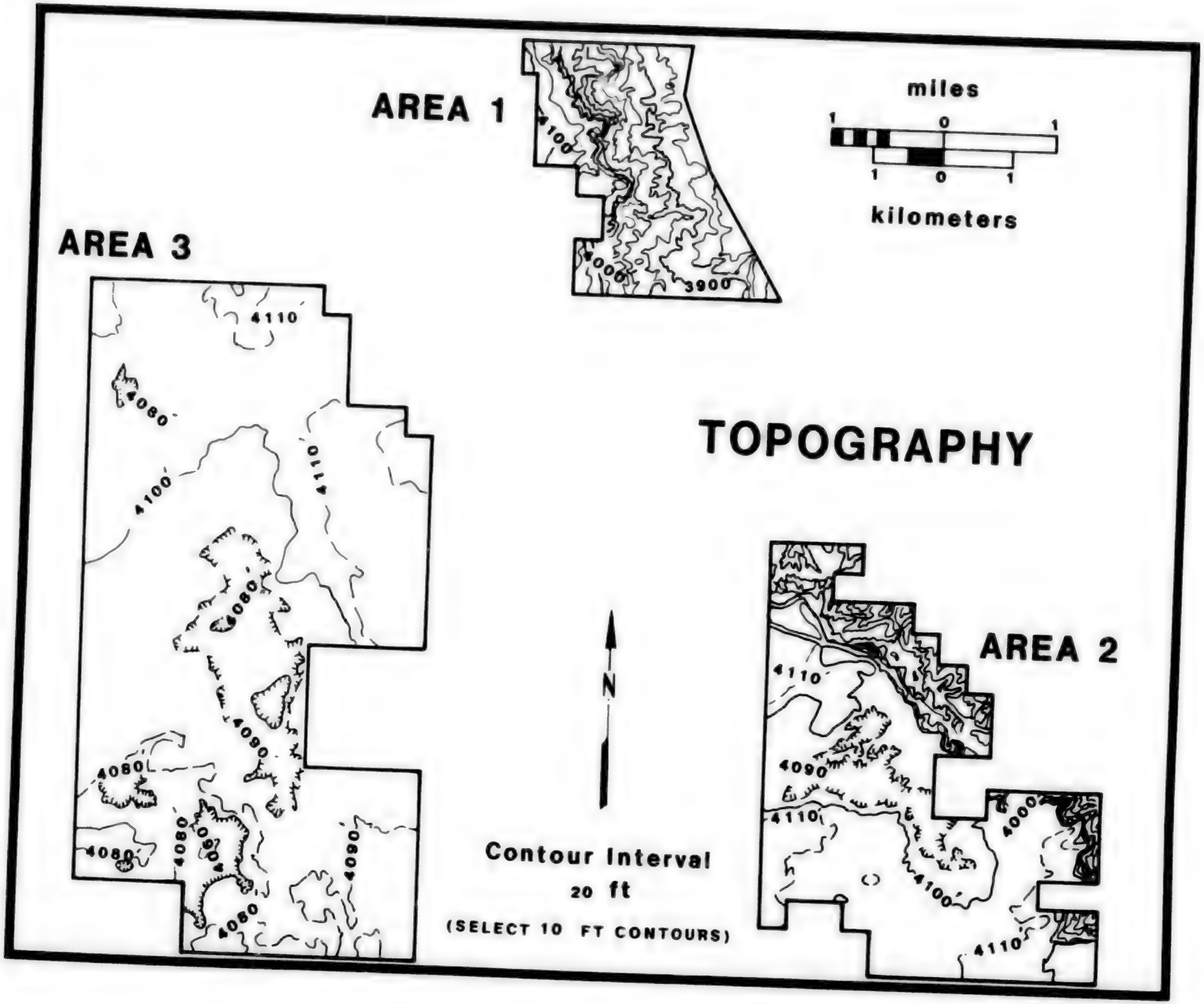


FIGURE 4.5.
SURVEY AREA TOPOGRAPHY.

low trough occupying the central portion of the area, as well as to a "ridge" system bordered by depressions in the southwest portion of the area. In Survey Area 2, there is an obvious gain in density along the West Mesa scarp. Rises in archaeological density also occur at the 4,105 and 4,410 foot contours in the northwestern portion of the area on a "hill" with a bordering slope and depressions on the north.

The strong correspondence between artifact densities and landform may in part be traced to factors which limit and induce archaeological visibility. Low density zones in each survey area correspond to depressions and other areas covered by an almost continuous sand mantle. Vegetation in these areas is dominated by indigo (*Dalea* sp.), broom snakeweed (*Gutierrezia* sp.) and patchy but sometimes dense grass cover. Given this vegetation cover, archaeological visibility is typically and understandably low. Surface cover in elevated areas consists of mesquite coppice sand dunes alternating with barren interdunal surfaces. Wind scoured interdunal surfaces provide high visibility windows on the archaeological landscape, thus densities commonly rise on slopes above depressions and low areas.

The above patterns are generally expectable, but what is not necessarily anticipated by (acknowledging differential degrees of) visibility is the relatively continuous high density distribution covering all elevated landforms. All elevated areas are characterized by relatively high artifact densities, greatest densities corresponding in a very regular fashion with highest elevations. As will be seen at a much more detailed scale with the Phase II surface data, densities rise is a very regular way with increases of less than 5 feet in elevation on smaller landforms within Phase II survey units. This pattern suggests that areas of high archaeological surface density reflect a more visible archaeological surface rather than simply the preferential selection of elevated areas for intensive use in the past.

If elevated areas had been targeted as preferred locations, one might expect some locations to have been more intensively used than others, these locations reflected in higher archaeological densities. The resultant archaeological surface would be one dotted with high Phase I artifact densities at preferred locations in elevated areas. This type of distribution does not occur, however. Instead, the archaeological landscape that can be depicted with the Phase I survey data indicate a relatively continuous high density blanket across elevated surfaces characterized by a regular decrease in density with very slight decreases in elevation. This pattern will be seen more clearly with the Phase II data presented in Chapter 8. If visibility is a central factor in determining archeological surface densities, one might also expect that surfaces at lower elevations may contain higher artifact densities than presently visible.

Obviously, a conclusive demonstration of differential artifact distribution with respect to elevation could be pursued by: (1) quantifying the potential visibility differences between areas of continuous sand mantle and exposed interdunal surfaces at a small scale, and (2) demonstrating the correspondence between slight elevational gains and higher archaeological densities at a large scale. Both lines of inquiry into factors which condition archaeological visibility require analysis of relatively large areas. The first study would demonstrate our differential ability to see exposed archaeological surfaces over relatively large areas of a square mile or more. In Area 3, for example, one must look at several 800 x 800 meter units together (e.g. Units 21 and 22 or Units 20 and 21) before visibility differences across the landscape are apparent. This mapping scale is a relatively small one considering the units most archaeologists use to document surface densities (e.g. 100 x 100 meters). The second avenue of study focuses on incremental increases in elevation and artifact density over much smaller areas such as those encompassed by low hill. In this case, analysis would proceed at a relatively large scale, using single survey units for example, to examine the relationship between elevation, exposure, and archaeological surface densities. This second kind of analysis is included in Chapter 8.

Analysis of Phase I Density Data

The tally data were collapsed into a few classes of items in order to simplify comparisons and to analyze categories of survey data potentially indicative of long-term or intensive residential occupation. It is these kinds of occupations which result in dense debris scatters associated with structures --the types of distributions slated for later, more detailed studies. To explore the potential for presence of remains reflecting intensively used residences in Phase I survey units, the chipped stone and groundstone, ceramic, and feature counts were classed into categories of containers, implements, and facilities that would "make sense" in terms of differentiating between short-term and long-term occupations as well as reoccupied locations. This analysis is thus geared toward management considerations, specifically toward recognizing areas with surface artifact densities and other remains that cannot not be adequately documented within the timeframe of the Phase II intensive survey, in-field analysis and program of small-scale excavation. Densely distributed archaeological materials some of which may be associated with substantial structural remains will require a long-term mitigation effort, beginning with a testing program that would document the level of effort required for adequate mitigation.

Six general categories of items were derived from the tally summaries. These categories are:

1. Non-portable containers (NPC). This category includes plain brownware and El Paso Bichrome and Polychrome sherd tallies. While not all vessels represented by sherds in this category could be expected to be so large as to inhibit portability, large volume containers have been documented for plain brownwares, especially late El Paso Brown (Whalen 1980:31-34) and El Paso Polychrome types. Large, thin-walled ollas the volumes of some of which exceed 45,000 milliliters have been recorded as a dominant vessel form for El Paso Polychrome (Rinaldo 1974:157). Since the decoration of El Paso Polychrome jars is limited to the upper half of the vessel exterior, spatially associated plain brownware and El Paso Polychrome sherds may actually represent El Paso Polychrome vessels. For these reasons, sherds of undifferentiated brownware and El Paso Polychrome are grouped together in this category.

2. Portable containers (PC). Chupadero and Mimbres Black-on-White types and Other types are included is this category. Sherds making up the Other class are primarily Ramos Polychrome. Vessel forms documented for these ceramic types include flat bottomed and hemispherical bowls, seed jars, and for Chupadero Black-on-White, small and large handled and unhandled jars. It is assumed that the size of most of these vessels would not preclude their transport.

3. Non-portable implements (NPI). The only lithic artifact class in this category is metates. While only a single complete metate was noted during the Phase I survey, inventoried metate fragments frequently represent relatively massive implements of sandstone conglomerate, vesicular basalt, and crystalline volcanic materials. Routine transport between processing locations of massive implements of this type is deemed unlikely. In all probability, not all items tallied as metates were prohibitively cumbersome to transport. Further, the extremely eroded condition of some sandstone metate fragments makes their classification as massive grinding slabs problematic, and small metate fragments in this category may also represent several shapes and sizes of grinding slabs. It is likely, however, that the implements presenting the most difficulty in terms of portability are counted in this category. (Smaller groundstone tools representing dual implements, those with both convex and concave grinding surfaces for example, were included in the mano rather than metate category.)

4. Portable implements (PI). All chipped stone and groundstone implements not categorized as metates were placed in this category.

5. Large volume processing facilities (LVF). Diffuse and concentrated FAR scatters make up this category. The volume of FAR making up these scatters, while not quantitatively documented by Phase I tallies, has been inferred to represent bulk processing or hearth reuse. Caliche, limestone, and cobbles making up the volume of FAR must be imported into most areas on the mesa top or quarried making reuse of these materials on the ground surface likely. FAR accumulations contrast with ash stains and small cobble rings inferred to represent constructed hearths.

6. Small volume processing facilities (SVF). Small circular to oval ash stains, burned cobble, caliche, and artifact-lined stains, and cobble/artifact rings without associated ash have been interpreted as small volume hearths. These

features lack associated burned rock or caliche clusters.

The above categories, the ceramic categories in particular, are in no way meant to represent phases or periods of occupation within the study area. Rather, it is assumed sequentially reoccupied seasonal residences characteristic of semi-mobile and sedentary systems and longer-term residences would be the places where permanent facilities occur. A high incidence of non-portable containers and implements could be expected at these locations in contrast to predominate use of portable implements at other locations.

Admittedly, this analysis uses gross categories of artifactual data to arrive at data classes reflecting portability and permanence. However, it can be reasonably argued that the particular data classes outlined above would generally include portable or non-portable items which may differentially occur at places depending on how they were used in the past. For example, feature reuse and intensive processing could be expected to occur at residential or task specific locations depending on whether plant food gathering was organized around mobile family groups or around the use of permanently established facilities. Small constructed hearths not associated with a volume of FAR or with permanently used facilities (such as non-portable containers) may represent single episode, special-purpose use of locations. Large volume facilities, such as mounded FAR concentrations, not associated with permanently used locations may, on the other hand, represent the bulk processing or seasonally reused processing locations.

Counts for artifact and feature categories were summed for each survey unit and then standardized using the number of LTMs surveyed in that unit. Since some units differed in size and number of transects walked, this procedure maintained comparable frequencies among survey units. In order to assign survey units to groups that share similar frequencies of containers, implements, and facilities described above, a hierarchical cluster analysis was then performed using Ward's method (Sokal and Sneath 1963). With this method, the distance between any two clusters of survey units is calculated as the squared Euclidean distance between all pairs of observations, consisting of one observation from both clusters (Sarle 1982:423). Euclidean distance is measured as the sum of the squared distance across the six categories of artifacts and features. A higher value of distance corresponds to less similarity between survey units, and a lower value represents more similarity. The numerical index used to aid in the selection of number of clusters obtained in this analysis is an approximation to the expected value of the within-cluster sum of squares and is called the cubic clustering criterion (Sarle 1982:419-420). With this measure, a plot of goodness of clustering versus number of clusters was obtained and number of desired clusters chosen.

Survey units from Areas 1 and 2 were analyzed together with six clusters of survey units obtained. The clustering solution for Area 3 survey units had seven clusters. Lists of the individual survey units contained in each cluster are provided in Table 4.5.a and b. Clusters differed among one another most dramatically in the overall frequencies and variety of artifacts, overall ceramic frequencies, frequencies of ceramics in the portable container category, and portable implement frequencies. Cluster statistics are summarized in Table 4.6.a and b with the analysis results described in the next section.

Survey Areas 1 and 2

Cluster 1: This cluster takes in a majority of the 164 survey units surveyed in Areas 1 and 2. The survey units in Cluster 1 are those characterized by lowest frequencies of ceramics in both portable and non-portable categories, portable lithic implements, and FAR scatters. All survey units located in the Leeward Slope Zone are included in this cluster. Other survey units are those located along the mesa scarp, especially in Area 1, and in southeastern portions of Area 2 where the mesa top contains a level expanse of sand mantle dotted with widely spaced, low grass covered hummocks. The sparse surface distribution in these areas may stem from a general paucity of archaeological materials as well as poor archaeological visibility due to erosional processes which have denuded the scarp edge and the ridges and slopes in the Leeward Slope Zone as well as to a sand mantle lacking deflated exposures. Some survey units in this

Table 4.5a. Survey units in Area 1 and 2 clusters.

Cluster 1			Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
1- 1	2- 5	2-110	1-19	2-12	1-26	2-29	2-64
2- 2	2- 8	2-111	1-20	2-13	2-41		
1- 3	2- 9	2-114	2- 6	2-17	2-42		
1- 4	2-10	2-115	2- 7	2-20	2-51		
1- 5	2-15	2-116	2-11	2-28			
1- 6	2-16	2-117	2-14	2-37			
1- 7	2-22	2-119	2-18	2-52			
1- 8	2-23	2-120	2-19	2-63			
1- 9	2-24	2-121	2-21	2-72			
1-10	2-30	2-122	2-25	2-113			
1-11	2-31		2-26				
1-12	2-32		2-27				
1-13	2-33		2-34				
1-14	2-35		2-38				
1-15	2-36		2-43				
1-16	2-39		2-44				
1-17	2-40		2-45				
1-18	2-49		2-48				
1-21	2-53		2-50				
1-22	2-57		2-61				
1-23	2-58		2-62				
1-24	2-59		2-65				
1-25	2-60		2-66				
1-27	2-69		2-67				
1-28	2-71		2-68				
1-29	2-73		2-70				
1-30	2-74		2-75				
1-31	2-78		2-76				
1-32	2-79		2-77				
1-33	2-81		2-80				
1-34	2-82		2-84				
1-35	2-83		2-87				
1-36	2-85		2-88				
1-37	2-86		2-93				
1-38	2-89		2-96				
1-39	2-90		2-100				
1-40	2-91		2-103				
1-41	2-92		1-112				
1-42	2-97		2-118				
1-43	2-98						
1-44	2-99						
1-45	2-101						
1-46	2-102						
1-47	2-104						
1-48	2-105						
2- 1	2-106						
2- 2	2-107						
2- 3	2-108						
2- 4	2-109						

Table 4.5b. Survey units in Area 3 clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
3-2	3- 8	3-15	3- 1	3- 3	3- 5	3-67
3-4	3- 9	3-18	3-17			
3-6	3-14	3-27	3-30			
3-7	3-16	3-28	3-47			
3-10	3-19	3-45	3-48			
3-12	3-21	3-46	3-59			
3-13	3-22	3-66	3-61			
3-20	3-23					
3-25	3-24					
3-26	3-29					
3-32	3-31					
3-36	3-33					
3-37	3-34					
3-38	3-35					
3-39	3-41					
3-40	3-42					
3-49	3-43					
3-54	3-44					
3-55	3-50					
3-58	3-51					
3-60	3-52					
3-64	3-53					
	3-65					

Table 4.6a. Area 1 and 2 Cluster Statistics.

Cluster	NPC	PC	NPI	PI	LVF	SVF
1 x- n=109	.32	.04	.07	1.07	.18	.002
2 x- n=39	2.99	.21	.52	8.04	.77	.008
3 x- n=10	17.07	.67	.65	14.7	.89	.015
4 x- n=4	46.84	2.79	.67	10.59	.60	0
5 n=1	125.62	1.56	0	24.06	2.50	0
6 n=1	87.65	9.21	1.40	51.56	2.03	0

Table 4.6b. Area 3 Cluster Statistics.

Cluster	NPC	PC	NPI	PI	LVF	SVF
1 x- n=22	.28	0	.04	.28	.19	0
2 x- n=23	.53	.13	.19	2.00	.48	.007
3 x- n=7	.66	0	.56	5.15	1.15	.04
4 x-X n=7	3.07	.08	.31	1.82	.41	.01
5 n=1	8.12	.08	.16	4.30	1.72	.23
6 n=1	19.06	0	0	.63	0	.63
7 n=1	8.0	0	2.50	24.5	1.50	0

cluster may contain distributions representing single events and simple single event composites and may also contain surface materials which have undergone considerable movement due to erosional processes.

Cluster 2: This cluster takes in 39 survey units most of which are located on the mesa top in Area 2. These survey units yielded low frequencies of ceramics in both NPC and PC categories and low to moderate frequencies of portable lithic artifacts. The frequency of FAR scatters (LVF) in survey units containing them is moderate to high as is metate (NPI) frequency -- average NPI and LVF counts in this cluster are as high as they are for other clusters with higher overall artifact and feature frequencies. The correlation between mean PI and LVF counts for clusters containing more than one survey unit is quite high, 0.91 (Pearson's product-moment coefficient). This correlation indicates potential similarities in the use of most areas with respect to activities involving FAR, chipped stone tools, manos, and hammerstones, and that some areas (those in clusters 2 and 3) may have been used or reused more intensively for activities involving items in the PI and LVF categories.

Cluster 3: The 10 survey units in Cluster 3 depart radically from the pattern presented by Clusters 1 and 2. These units contain moderate to high frequencies of ceramics in NPC and PC categories, and high NPI and PI frequencies. FAR scatters also occur at relatively high frequencies. In a number of instances, survey units in this cluster occur adjacent to those in Clusters 4, 5, and 6 indicating that these units encompass marginal portions of very high density distributions which continue through several survey units. In other instances, differences in artifact frequencies among survey units in Clusters 3, 4, 5, and 6 are due the the variable placement of survey transects relative to dense midden deposits -- transects cutting through midden margins obtaining lower artifact counts than those bisecting middens. By inference, high NPC and NPI counts reflect the presence of non-portable and therefore relatively permanent facilities in these survey units. In addition, to varying along a portability dimension, NPC and PC categories may also represent variable use of containers as storage vessels or serving and processing containers. The NPC category includes vessels used as non-portable containers or facilities for storage. High PC counts while reflecting the use of portable containers also indicate the use of everyday domestic serving vessels. An interpretation of relatively intensive residential use for areas in Cluster 3 survey units is thus reinforced by high counts of both ceramic categories.

Clusters 4, 5, and 6: Four units are included in Cluster 4. Clusters 5 and 6 each contain a single survey unit. Survey units in these clusters are characterized by extremely high NPC, PC, and PI counts. In comparison to units in Cluster 3, units in Cluster 4 have much higher PC frequencies which may indicate a organizational difference in residential use among survey units in these two clusters. Differences in artifact and feature frequency among these units may also be due to transect placement. An interpretation of residential use and intensive reuse of portions of these survey units as well as some units in Cluster 3 is substantiated by testing and feature evaluation findings (see following section) with adobe wall alignments and artifact-filled ashy deposits interpreted as midden or room fill present in a majority of these survey units.

Survey Area 3

Cluster 1: The 22 survey units in Cluster 1 are characterized by extremely low NPC, NPI, and PI frequencies and the absence of inventoried materials in the PC and SVF categories. Similar to low density survey units in Areas 1 and 2, these units are the ones with a relatively continuous sand mantle and may also contain distributions resulting from single events and event composites representing single occupations.

Cluster 2: Low to moderate frequencies (in comparison to other Area 3 survey units) of all variable categories are present in the 23 survey units in this cluster. All survey units in this cluster occur in mesa top areas with little relief lacking ridges or major deflation basins. Low archaeological visibility in these areas may be dependent to a major degree on lack of exposed surfaces.

Cluster 3: High PI, LVF, and low PC frequencies characterize the 7 units in Cluster 3. The high correlation found between mean PI and LVF for

Area 1 and 2 clusters also holds for these survey units (r=0.96). Survey units in this cluster occur in mesa top areas with considerable relief--those areas on the edges of major deflation basins and along ridge slopes. Again, the degree to which archaeological visibility has been facilitated by erosional processes must be considered. However, one might expect ceramic frequencies to have increased on an order of magnitude similar to that of ceramics in Areas 1 and 2 if differences in ceramic and lithic counts between units in Clusters 2 and 3 were purely due to natural factors.

Cluster 4: Survey units in this cluster contain a high variety of materials with all categories of items represented at low to moderate frequencies. All units are located on relatively level surfaces lacking major depressions and slopes. The extent to which interdunal deflations occur in these units is not known. Many of these units lie within a yucca coppice dune zone that lacks a regular pattern of alternating dunes and interdunal surfaces, instead small deep deflation pockets occur in parabolic dune fields. In some instances, high NPC and PC counts (in transect tallies) reflect the sherds of a single vessel. The occurrence of single vessel scatters lacking other associated artifacts is some evidence for the presence of single event distributions in these low to moderate density survey units.

Cluster 5: The single survey unit in this cluster contains the highest NPC, PC, LVF, and PI frequencies of any unit in Area 3. Phase I survey notes describe relatively dense distributions of artifacts and FAR in the northern and southern portions of the eastern half of this survey unit. (This impression was subsequently verified during intensive Phase II survey of the unit (see next section). The high artifact and feature frequencies here may be a function of greater archaeological visibility on a ridge extending into this unit from the north, the highest elevated landform in Area 3. In addition, at least one very high frequency single vessel scatter has contributed to the PC count. The sizes of the artifact distributions in the northern and southern portions of the unit (approximately 400 x 300 meters) may be attributable to large spatial composites of debris resulting from reuse of the area possibly for residential and special-purpose functions.

Cluster 6: A single scatter of 66 brownware sherds is responsible for the high NPC count in the survey unit in Cluster 6. Northern portions of this unit bordering a ranch and adjacent trash dump have been highly disturbed.

Cluster 7: A single survey unit measuring roughly 10 hectares makes up this cluster. The relatively small size of this unit may be in part responsible for the very high NPI and PI counts since it is unlikely that the dense distribution of lithic artifacts transected would have continued throughout a standard-sized 64 hectare unit.

In summary, while the co-occurrence of features, structures, and dense artifact accumulations in some units is evidence for residential and intensive reuse of some places on the mesa top, visibility differences among survey units also contribute to the above patterns. These differences are especially apparent when metate fragment (NPI) and FAR scatter (LVF) counts from mesa top survey units in Areas 1 and 2 are examined. These counts are very similar for Clusters 2, 3, and 4 suggesting that the discovery rate during survey for these items (which because of their size are probably the most visible surface materials) is similar among most units in these clusters. Thus, it could be inferred that aeolian scouring of interdunal surfaces exposes these materials to the same degree and that a threshold has been reached for the rate of their discovery in most areas on the mesa top. The higher frequencies of metate fragments and FAR scatters in Clusters 5 and 6 can be linked with extremes in elevation and exposure. Units 29 and 64 comprising these clusters are situated on the denuded West Mesa scarp and on an elevated surface exposed to the southwest, respectively. The level of visibility and corresponding discovery rate at these places for metate fragments and FAR scatters are probably the highest for mesa top surfaces.

The visibility and corresponding discovery rate for smaller lithic, groundstone artifacts in the NPC, PC, and PI categories may have reached a threshold for most mesa top areas in Clusters 3 and 4 which have similar frequencies of these items, while ceramic frequencies continue to increase in Clusters 4, 5, and 6. One reason for the differential visibility of smaller lithics and ceramic artifacts may be color--brownwares being more difficult to detect on the backgrounds of reddish-brown paleosol and tan sand mantle than colored cherts and crystalline volcanic rocks. Models of relationships between visibility, as conditioned by item "obtrusiveness", and discovery rate for metate fragments, FAR scatters, portable lithics, and ceramics are illustrated in Figure 4.6.

Results of the cluster analysis also elaborate upon the impressions gained from inspection of raw artifact counts. High density units containing a variety of remains were readily identified demonstrating that Phase I methods when summarized analytically were reliable indicators of relatively large (50 meter or larger in minimum dimension) surface distributions often associated with subsurface remains. Perceived surface concentrations smaller than 50 meters in maximum extent, while they may theoretically be transected by one individual and thus have their content sampled, are not differentially detectable in the cluster analysis from units containing multiple low-to-moderate density distributions. Identification in the field of these smaller distributions, and subsequent subsurface evaluation of these locations were the methods followed to document these areas.

Subsurface Remains in Clustered Units

All moderate to high density units (Clusters 2, 3, 4, 5, and 6) in Areas 1 and 2 that contained perceived surface concentrations of material were evaluated for subsurface remains by testing crews. Two units, 12 and 17, were not returned to since survey notes already indicated the presence of features in each. Because surface concentrations were not noted in most low density units, these units were not systematically evaluated by testing crews for subsurface features. Low density units where features or surface concentrations of artifactual material were noted on survey, however, were tested. These include units 33, 57/58, 60, 69, 92, and 104.

A review of Appendix C will indicate that all high density units where subsurface features were found are identified by the cluster analysis. For Areas 1 and 2, high density clusters (3, 4, 5, and 6) contained a total of 16 units, 13 of which yielded evidence of subsurface features when subsequently evaluated. Field impressions gained from survey indicate that either large continuous distributions or multiple, smaller concentrations of artifacts and features contribute to high densities in these units. For Areas 1 and 2, only 3 of the 39 moderately dense survey units in Cluster 2 yielded evidence of subsurface material, although all moderately dense units where surface concentrations of artifacts were noted were tested. Three units (Units 33, 57/58, and 104) out of 164 low density units in Cluster 1 were found to contain subsurface remains. In general, low-to-moderately dense units containing subsurface remains in single or small distributions (Area 1: Unit 20; Area 2: Units 6, 11, 33, 57/58, 104) were not differentiated by the cluster analysis from those lacking documented subsurface remains.

In Area 3, most perceived surface concentrations of artifacts and features were evaluated by testing crews for the presence of subsurface remains. Most units in Cluster 3, 4, 5, and 7 (13 out of 16 units) contained such concentrations and of those evaluated a majority (8 out of 11) were found to contain subsurface cultural deposits or concentrations of FAR. Fewer units in Clusters 1 and 2 (13 out of 45 units) contained such concentrations although of the ones tested almost all (7 out 8) had subsurface ashy deposits or burned rock indicating the presence of structures and features. These results indicate that buried features, although not as densely distributed in Area 3 as in Area 2, are more ubiquitous there.

In sum, Phase I survey results when summarized analytically were reliable indicators of relatively large (50 meters or larger in minimum dimension) surface distributions often associated with subsurface remains. Units where perceived surface concentrations are smaller than 50 meters in maximum extent, while they may be sampled for density information, are not differentially recognized in the cluster analysis from units containing low-to-moderate artifact densities in dispersed distributions. Documentation of the locations of these smaller distributions during

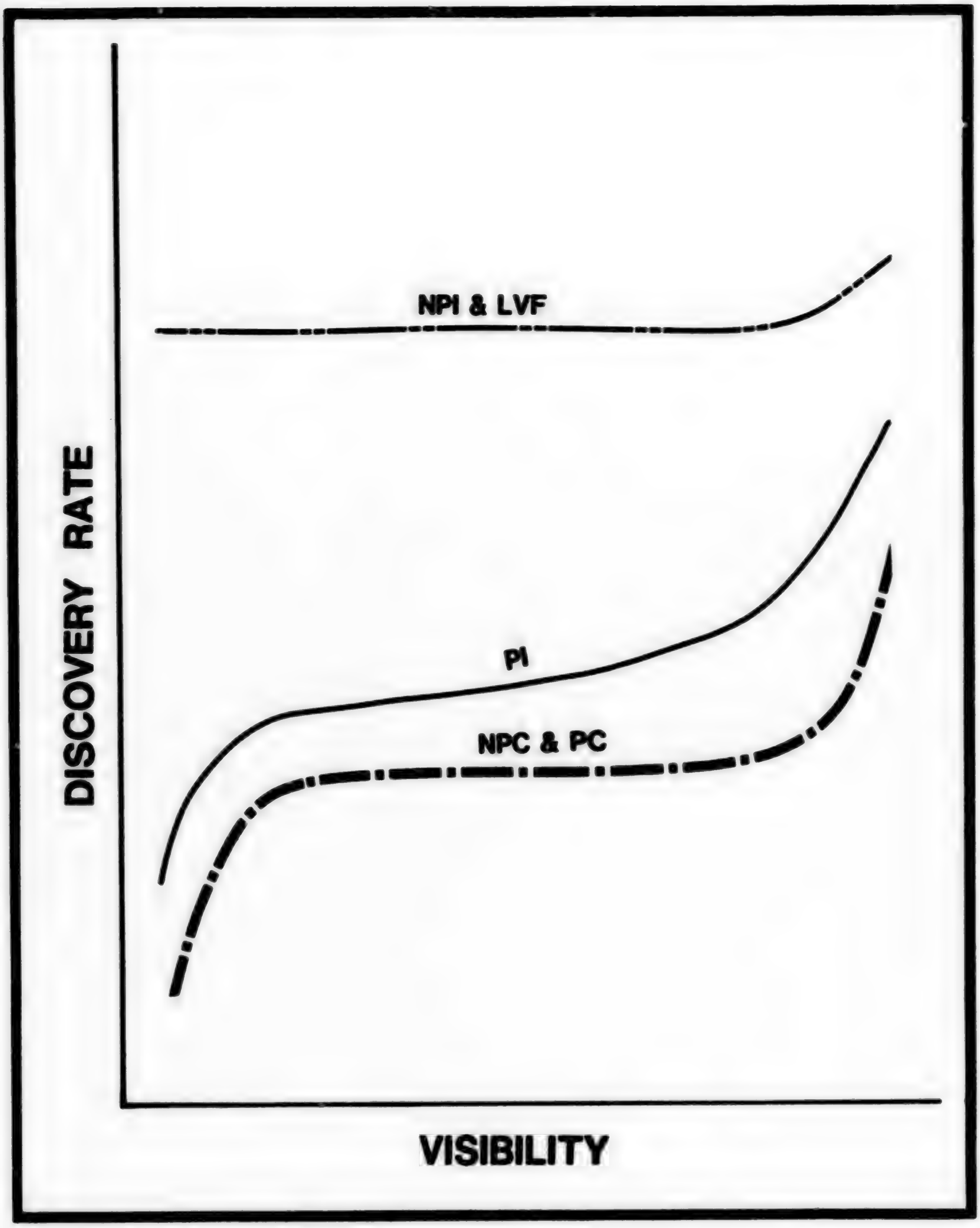


FIGURE 4.6.
LEVEL OF VISIBILITY VERSUS DISCOVERY RATE FOR ARTIFACT CATEGORIES.

survey, and subsequent subsurface testing were the methods followed to identify buried features in these areas.

PATENT RESTRICTIONS

Phase I survey and evaluation confirmed that large portions of the proposed exchange lands are characterized by low density artifact scatters which are redundant in content and which are well enough exposed to lend themselves to investigation through the Phase II in-field analysis. However, other areas were identified which seem likely to contain complex sets of remains from residential and nonresidential use of places. These areas would be both expensive and time consuming to adequately evaluate much less excavate in their entirety. Because they are clearly critical to understanding prehistory in the El Paso area, these cultural properties should be retained in public ownership and managed for the long-term extraction of the information which they contain. Similarly, the late 19th Century and early 20th Century railroad construction camps represent a prominent episode in both regional and national history. These properties should not pass out of Federal control until they have been adequately documented. Such a task was clearly beyond the timeframe of this project.

Tables 4.7 and 4.8 list survey units on public land selected for application of land patent restrictions accompanying the NHLEP which are currently managed by the Las Cruces District (Figure 4.7). This list includes all units containing documented historical remains (Appendix D) for which mitigation procedures require archival research as well as in-field mapping, excavation, and laboratory analysis of remains. Listed survey units containing prehistoric materials require intensive surface documentation, subsurface testing and excavation and include those identified by the analyses described above (Area 1 and 2 Units in Clusters 3, 4, 5, and 6). Portions of low-to-moderately dense units containing restricted surface distributions at which subsurface features were detected are also listed. Several other partial units listed are those bordering high density units or units containing observed structural remains lacking high surface artifact densities.

Table 4.7. Survey Units Identified for Application of Patent Restrictions.

Area	Survey Unit
1	26
	20 S 1/2
2	5
	6 SE 1/4
	8
	11 SE 1/4
	12
	13
	14
	17 S 1/2, NE 1/4
	20
	21 W 1/2, SE 1/4
	24 N 1/2
	28 E 1/2
	29 W 1/2
	33 NE 1/4
	37
	38 W 1/2
	41
	42
	46
	47
	51
	52
	54
	55
	57 5-acre parcel on mesa top
	58 5-acre parcel on mesa top
	63
	64
	72 NE 1/4
	94 SE 1/4
	95 SW 1/4
	104 N 1/2
	113 N 1/2

Table 4.8. Archaeological and historical remains in parcels under patent restriction.

AREA I

UNIT	PROVENIENCE	FEATURES
20 S½	II-20-1	MIDDEN WITH POSS. STRUCTURE
26	II-26-1	MIDDEN WITH POSS. PUEBLO OR PITHOUSE

AREA 2

UNIT	PROVENIENCE	FEATURES
5 AND 8	II-5-1	CAN AND BOTTLE DUMP 1881
	II-5-2	RAILROAD CONSTRUCTION CAMP 1881
	II-8-1	TENT DUMPS + SCATTER HISTORIC TRASH 1881
6 SE¼	II-6-1	SCATTER WITH FEATURE
11 SE¼	II-11-1	SCATTER WITH STAIN
12	II-12-1	UNEVALUATED SCATTER
	II-12-2	UNEVALUATED SCATTER
	II-12-3	UNEVALUATED SCATTER
	II-18-1	SCATTER WITH FEATURE/STAIN (CONTINUOUS WITH 11 12-3)
13	II-13-2	SCATTER WITH STAIN
	II-13-3	SCATTER WITH POSSIBLE STRUCTURE
	II-19-2	SCATTER (CONTINUOUS WITH II 13-3)
14	II-14-1	HISTORIC CAMP 1902
	II-14-2	LITHIC SCATTER
	II-14-3	LITHIC SCATTER
	II-14-3	LITHIC SCATTER
17 S½, NE¼ 24 N½	II-17-1	SHEET MIDDEN WITH POSS. STRUCTURE
	II-24-1	DENSE SCATTER
	II-24-2	SCATTER
20, 21 W½ and SE¼, 28 E½ and 29 W½	II-20-1	MIDDEN
	II-20-2	UNEVALUATED SCATTER
	II-21-1	SCATTER WITH FEATURE
	II-28-1	SCATTER
	II-29-1	SCATTER WITH STAINS
33 NE¼	II-33-1	ADOBE STRUCTURE
37 AND 38 W½	II-37-1	SCATTER
	II-37/38-1	DENSE SCATTER WITH STAINS
41 AND 42	II-41-1	HIGH DENSITY SCATTER
	II-14-2	UNEVALUATED SCATTER
	II-42-1	SCATTER WITH STAINS
	II-42-2	ADOBE STRUCTURE
46,47,54 AND 55	WORLEY PUEBLO	HIGH DENSITY SCATTER WITH STAINS 50+ ROOM PUEBLO
51,52,63 AND 64	II-51-1	SCATTER WITH STAIN
	II-51-2	CONTINUOUS WITH II-52-1
	II-52-1	MIDDEN, SCATTER WITH STAINS
	II-63-1	SCATTER WITH STAIN
	II-63-2	SCATTER WITH STAIN
	II-64-3	SCATTER WITH STRUCTURE
	II-75-3	SCATTER
	II-64-1	SCATTER WITH POSS. STRUCTURE
	II-64-2	SCATTER
	II-76-4	STRUCTURE (CONTINUOUS WITH 64-3)
57 AND 58	II-57-1	MIDDEN WITH POSS. STRUCTURE
72	II-72-2	SCATTER WITH POSS. FEATURES
	II-72-3	SCATTER WITH POSS. FEATURES
94 SE¼ 95 SW¼ 104 N½	II-104-1	MIDDEN WITH POSS. PUEBLO
	II-104-2	SCATTER
	II-104-3	UNEVALUATED SCATTER
	A-1	SCATTER
	A-2	SCATTER WITH FEATURE
	A-3	SCATTER
	A-4	SCATTER
113 N½	ANAPRA PUEBLO	8 ROOM PUEBLO WITH FEATURES

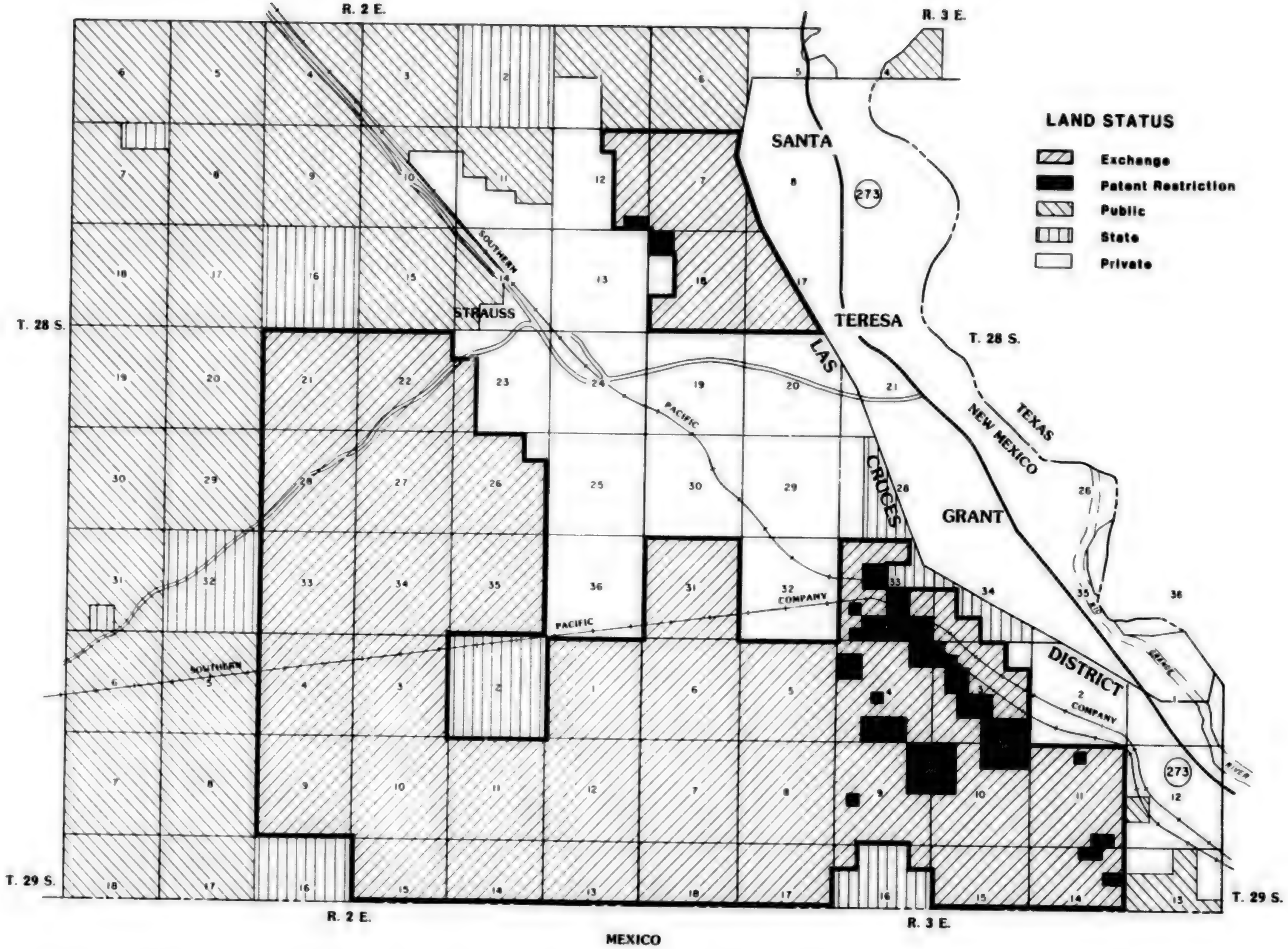


FIGURE 4.7.
LAND STATUS MAP OF THE NAVAJO-HOPI LAND EXCHANGE AREA.

93

93

PHASE II SURVEY

by Eileen L. Camilli, James I. Ebert, Signa L. Larralde, and Luann Wandsnider

All archaeologists who have done surface survey have encountered situations in which it was difficult to decide where sites ended and where other sites began. This is because of the implicit, unstated, and vague internalized notions that archaeologists have held concerning the equivalence between behavioral episodes in the past and "sites" as they exist in the present. The systemic nature of human mobility, the effects of curation and the anticipatory manufacture and use of components of technical systems, disparities between the tempo of episodes of discard versus episodes of deposition, and the post-depositional action of natural processes on deposited materials all combine to ensure that the archaeological record in most, if not all places, is complex. It exists on a level quite different from that of specific episodes of human behavior. What is more, the complicated overlayering brought about by these processes results in an archaeological record that in many places does not exist as discrete "sites" or activity sets, but is rather of a dispersed, continuous nature (Dunnell and Dancey 1983; Foley 1980, 1981a, 1981b; Isaac and Harris 1975; Thomas 1975). Further, it is clear that different nodes on the landscape will assume many different functions through time. Rather than discussing what function a "site" had, it is more meaningful to look at variability in the occurrence and co-occurrence of attributes and of artifacts through space.

When the above considerations are taken into account, the significance of the archaeological record assumes a wholly different emphasis. It should be clear that work needs to begin on unravelling the distributions that are the most comprehensible to us given the complexity of archaeological formation processes and the current state of development of archaeological methodology. Information about the past can best be extracted from those parts of the archaeology of an area which are redundant and easily analyzed. One can only begin to find patterns in the surface archaeology if there exists some amount of redundancy in that data. In essence, then, the parts of the archaeological record which can contribute the most information at present, and which thus must be considered highly significant, are low-density, redundant distributions. These materials are common in the study area.

The Phase II Sample

A stratified random sampling design was employed to choose survey units totaling approximately 8 percent of the study area to be intensively documented during Phase II. Phase II survey units were transected at 5 meter intervals with all discovered cultural remains analyzed in the field. The sampling design treated Areas 1 and 2 separately from Area 3 since they were originally surveyed during Phase I with a smaller grid and present different sampling considerations due to the extensive areas of rough terrain and the presence of historic resources.

Survey units were initially stratified on the basis of cluster analysis results, groups thus derived reflecting the general range of variability in contents of all survey units in the study area. Survey units from Clusters 1 and 2 in Areas 1 and 2 were sampled. Units in Cluster 1 are those with the lowest frequencies of prehistoric materials and are located on the mesa top and below the mesa scarp. The units in Cluster 2 are all located on the mesa top in Area 2 and are characterized by low-to-moderate frequencies of lithic artifacts and low frequencies of ceramic artifacts. In comparison to units in Cluster 1, FAR scatters are more abundant.

In order to determine number of units to be sampled, all units listed for land patent restrictions (see previous section) were first excluded from the sample population. Most of these units were contained in Clusters 3, 4, 5, and 6. Other units listed for application of patent restrictions in Clusters 1 and 2 include those with high densities of historic materials and small, moderate-to-high density areas of prehistoric materials found to be associated with buried structures. Sample units in Cluster 1 were further separated into mesa top units and units situated on the mesa scarp and in the broken terrain below (Table 4.9). Those odd-sized units along the project boundary in Areas 1 and 2 and in Area 3 were not considered for sampling.

Table 4.9a. Areas 1 and 2 sample population (unit size= 16 hectares).

Cluster	Unit type	No. Units	No. Selected Units	Rate
1	West Mesa	42	3	7.14%
	Breaks	47	2	4.26%
2	West Mesa	32	3	9.38%
TOTALS		121	8	6.61%

Table 4.9b. Area 3 sample population (unit size= 64 hectares).

Cluster	Unit type	No. Units	No. Selected Units	Sampling Rate
1	Interior West Mesa	22	1	4.50%
2	Interior West Mesa	23	1	4.30%
3	Interior West Mesa	7	1	14.28%
4	Interior West Mesa	7	1	14.28%
5	Interior West Mesa	1	1	100.00%
TOTALS		60	5	8.33%

Total Sampling Universe	Area Sampled	Sampling Rate
5.776 hectares 14,272.5 acres	448 hectares 1,107 acres	7.76%

Clusters 1 through 5 make up the sample population for Survey Area 3 (Table 4.9). With the exception of more abundant isolated FAR, Clusters 1 and 2 are roughly comparable to Cluster 1 units in Areas 1 and 2. Cluster 3 is comprised of units with high chipped stone, mano and metate, and FAR scatter frequencies along with moderate amounts of brownware. Cluster 4 includes units with a high variety of items of which brownware ceramics occur most frequently. Cluster 5 is represented by a single unit exhibiting high densities of ceramics, chipped stone, and FAR. Survey units in Clusters 6 and 7 not considered for sampling are a unit suffering extensive mechanical disturbance and an odd-sized unit along the international border, respectively.

A Phase II 5 percent sample of lower density survey units was initially targeted. Table 4.10 lists the sample population, number of units selected, and sampling rate for all survey areas. Considered together, all mesa top low density clusters were sampled at approximately a 5 percent rate (this figure is based on 89 16-hectare units in Cluster 1 for Areas 1 and 2 and 45 64-hectare units in Clusters 1 and 2 for Area 3). Higher density clusters were sampled with a target sample placed at 10 percent. Survey units with higher surface artifact densities included 3 16-hectare units in Area 2 (Cluster 2) and 3 units from each of the Area 3 higher density clusters (Clusters 3, 4, and 5).

Since few units are contained in the higher density clusters in Area 3, the number of units selected is small and the sampling rate is well above 10 percent. A smaller sample unit size would have raised the number of units selected for sampling but was not possible to achieve for Area 3, since the original unit of observation during Phase I was an 800 x 800 meters (64 hectares) quadrate. In addition, the sample stratification is based on a cluster analysis of the contents of 800 x 800 meter survey units in Area 3, the sample strata being clusters of survey units. Thus, subdivision of Area 3 into smaller parcels for the Phase II survey would have resulted in sample units which were not necessarily representative of the original clusters.

Selected sample units are listed in Table 4.10. Because of the exclusion of units under patent restrictions from Phase II survey and the use of large units of observation in Area 3, the actual sample size is quite small and precludes statistical demonstrations of sample representativeness.

Phase II Survey Procedures

Following the argument presented by Ebert and others (1983), two ideas guided the Phase II survey design: that the units of analysis (which here include units of discovery as well) structure not only what is written about after the survey is over but indeed what is found during fieldwork (Binford and Sabloff 1982); and that very little is actually known about the structure of archaeological record in the study area or about what it may mean. Consequently, the units of analysis employed during the survey must be units with little or no meaning already attached. Therefore features and attributes of artifacts were chosen as the units of mapping and data recording, and artifacts and features chosen as the units of discovery; and, the survey was designed for maximum data recovery of these units of discovery and analysis.

Table 4.10. Phase II sample units.

Areas 1 and 2	Area-Unit
Cluster 1 (Breaks)	1-16
	2-3
Cluster 1 (West Mesa)	1-1
	2-32
	2-110
Cluster 2	2-25
	2-75
	2-50
Area 3 (Interior West Mesa)	**Unit**
Cluster 1	2
Cluster 2	21
Cluster 3	45
Cluster 4	48
Cluster 5	3

The results of the survey are influenced first by what is found, i.e. strictures about what is recognized as an artifact plus bias inherent in the discovery procedure; secondly, by what is considered to be appropriate to record; and thirdly by how it is recorded -- the format of data recording. An attempt was made to control each of these three influences in an explicitly self-conscious manner, by planning and executing the survey in several ways that differ from the procedures employed by traditional surveys.

The methodological approach outlined here is consistent with the structure of surface archaeology and maximizes the quality and quantity of information recovered about the past. Data recovery was organized around three separate crews, a discovery crew, a mapping crew, and a data recording crew. The field procedures carried out by each crew are detailed in Appendix B. The success of a survey of this kind is dependent to a large extent on crew cooperation (Ebert 1983; Ingbar, Larralde and Wandsnider 1983), and the fact that each crew is able to carry-out their respective activities apart from the other crews contributes greatly to the information yield of this project. A systematically organized, multi-component survey crew allows portions of the crew to complete their tasks at their own speed and under ideal conditions. The use of three crews (discovery, mapping, and analysis) which essentially work "on their own" in this survey facilitates greatly the yield of actual product (in terms of information) per person-hour worked.

During the Phase II intensive survey, the discovery crew was responsible for locating artifacts and features and providing information on a discovery form (Appendix E) which guided later analysis and mapping. With a crew spacing of 5 meters apart, each of 16 sweeps across a unit had 5 survey positions. Five surveyors pinflagged the locations of discovered artifact and features with orange-colored pinflags. Surveyors also counted the number of pinflags used with a tally meter. At the end of each sweep, the crew chief recorded the number of flagged artifacts for each position, ending time of the sweep (the beginning time noted at the commencement of the sweep), and noted weather conditions. Discovery tallies are listed in Appendix E for each Phase II survey unit. In instances where dense FAR or artifactual materials occurred over limited areas, a one-by-one meter grid system was superimposed on the distribution at the end of the discovery phase and artifact locations were subsequently recorded by 1 meter on a side grid squares.

Analysis crews subsequently logged numbers assigned to artifacts and artifact grids while performing an in-field analysis of lithic and ceramic artifacts. In addition, the analysis crew commonly discovered other artifacts which were flagged with red-colored pinflags. Flag color was then coded as one of the artifact attributes. Chipped stone and groundstone artifacts were coded in the field on a single form; the coding format for which is presented in Chapter 6. All obsidian artifacts and formal chipped stone tools (unifaces, bifaces, and projectile points) were collected for inclusion in later ancillary studies. Ceramics, bone, shell, and historic artifacts were recorded on a separate form. The in-field coding format for ceramics is presented in Chapter 7. In addition to all rim sherds, ceramic types 5 through 24 (see Table 7.1) were collected for laboratory identification. Bone, shell, and historic artifacts which were extremely rare in Phase II sample units were cataloqued on the same code sheet with ceramics as a matter of expedience. All of these latter materials were collected. Crews also described all surface features encountered in Phase II units with a consistent format (Appendix B, Figure 7).

Mapping crews then recorded the locations of numbered artifacts, features, and grids in a consecutive tally with an electronic distance meter (EDM). The angle and distance to each artifact or feature marker, or grid corner in the case of gridded surfaces, were recorded from a mapping station established in each unit. Because the EDM lacked an automatic data recorder, each set of measurements was entered into a log book of successive flag numbers by a "scribe" at the instrument station. As this was a very time consuming process, the vertical angle, or plunge, for each item was recorded only if it exceeded 3 degrees from a true horizontal measurement.

Although the amount of ground "covered" during this time was considerably less than walked during most traditional site surveys, the information yield is staggeringly greater due not only to the methodology employed in fieldwork in general, but also to the modular crew organization. The information-yield argument is very important when considering the cost-effectiveness of field data collection programs, such as this one, since what is to determine the "effectiveness" part of this equation is the amount of useful archaeological data recovered and not the amount of "ground covered" about which virtually nothing is known. The former criterion, it was felt, was the most important, in determining what survey methods and intensities should be employed.

PHASE II SURVEY RESULTS

In-field analysis of piece-plotted (or gridded) artifacts and features was accomplished for 8 400 x 400 meter survey units in Areas 1 and 2 and for 5 800 X 800 meter units in Area 3. Area 3 survey units were divided into more manageable quarters (designated NE,SE,NW, and SW) and actually surveyed in these smaller units. Table 4.11 lists artifact and FAR counts for each survey unit. In all, 40,350 artifactual items and 155 features were recorded in the 448 hectares intensively surveyed in the NHLEP area. (Groundstone artifacts in this list include all chipped stone with groundstone attributes; for example, a groundstone fragment may have been attribute-coded as a flake of chipped stone and as a piece of indeterminate type groundstone. All such items with dual type codes were placed in the groundstone inventory.)

Surface visible features recorded include surficial ashy deposits indicative of buried pits and pit structures or the eroded remnants of such features some associated with fire-altered caliche or artifactual materials, mounded accumulations of fire-altered caliche, and more dispersed fire-altered caliche scatters. FAR features very frequently includes fire-altered fragments of groundstone and hammerstones. Table 4.12 lists all features recorded during the Phase II survey. Each feature was tested for horizontal extent and depth of subsurface staining using a soil probe and associated surface artifacts and FAR were described on a feature evaluation form (See Appendix B). In all, 155 such features were located and recorded in Phase II survey units.

Artifact Distributions in Phase II Survey Units

Artifact and feature distributions mapped by the Phase II survey are depicted in Figures 4.8 - 4.19. These maps illustrate continuous archaeological surface distributions containing lithic and ceramic artifacts along with FAR across the surfaces of 400 x 400 and 800 x 800 meter survey units. These maps were produced from the point-plotted and gridded locational data recorded during the intensive survey.

Some surfaces proved too densely distributed with material for all items actually recorded to be plotted. To avert the problem of torn plots due to the inking of an excessive number of points in one place, the original plots were "filtered" so that only one of each artifact/feature symbol was plotted within a 2.5 x 2.5 meter grid. The original 8 1/2" x 11" and 13" x 13" plots were then reduced to page size for this report.

Surface densities vary across units and at the scale depicted here can be attributed, in part, to a complex set of physiographic circumstances. Exposure, degree of relief, maximum elevation, and location with respect to deflation hollows each covary with the percentage of modern sand cover versus percentage of surface in interdunal deflations in survey units. One or more of these factors appear to be regulating the surface visibility of artifacts and thus the discoverability of artifactsand features at the scale recorded here. Artifacts are exposed primarily on deflated interdunal surfaces and can be presumed to have been so exposed during the past, as well. Thus, artifact visibility and discovery in the present as well as in the past can be modeled as contributing to present archaeological surface distributions. This issue will be explored in greater depth in Chapter 8, Spatial Analysis of the Distributional Data base.

It is possible, however, to offer generalizations concerning variation in surface distribution densities on the basis of comparisons between surface densities and topography. These comparisons indicate several contexts for high and low archaeological densities:

1. Survey units with lowest archaeological densities are situated in the Leeward Slope

Table 4.11. Discovered artifact frequencies in Phase II survey units.

Survey Area	Unit	Chipped Stone	Groundstone	FAR	Ceramics	Features
1	1	191	37	1459	24	15
1	16	1	0	0	4	0
2	3	23	1	1	12	0
2	32	332	87	250	52	1
2	50	476	215	202	1222	7
2	75	1333	265	388	128	8
2	110	546	146	570	41	4
2	2	173	46	2671	173	0
3	3	2485	626	6674	1118	35
3	21	1931	377	3240	921	29
3	45	4154	909	3143	112	38
3	48	474	201	236	997	12
TOTALS		12,939	3092	19,105	5214	155

Table 4.12. Discovered features in Phase II Survey Units.

SURVEY UNIT	ASH-STAINED DEPOSITS PRESENT	FAR FEATURES	OTHER*
Areas 1 and 2			
1	1	14	
25	1	4	1
32	0	1	
50	4	2	1
75	6	2	
110	1	3	
Area 3			
3	21	13	1
21	17	12	
45	26	11	1
48	11	1	
TOTALS 88	63	4	= 155

NOTE: * Other features include a modern hearth and three features which upon testing lacked FAR or ash-stained soil or proved to be stains of organic origin.

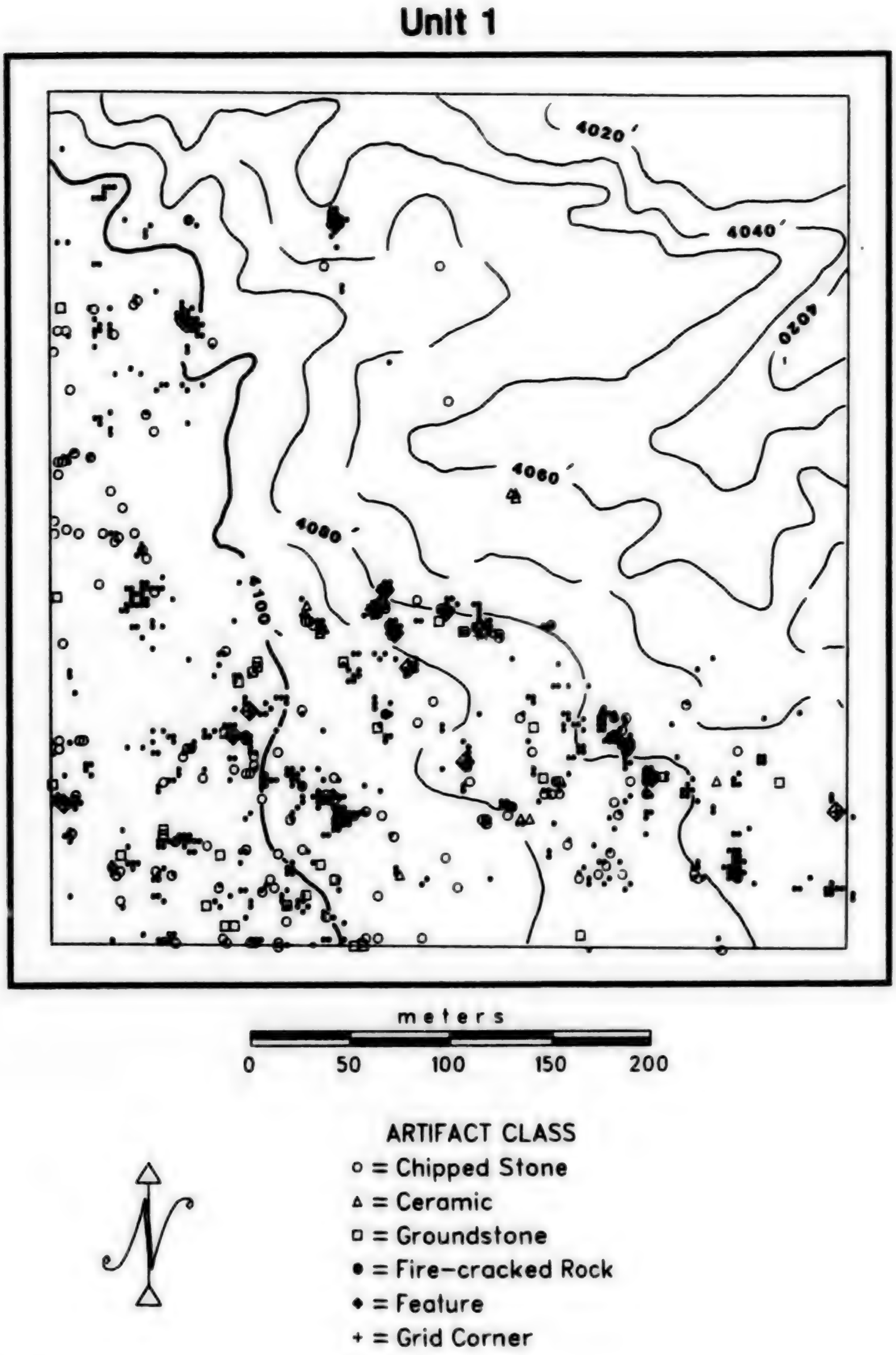


FIGURE 4.8.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 1, SURVEY AREA 1.

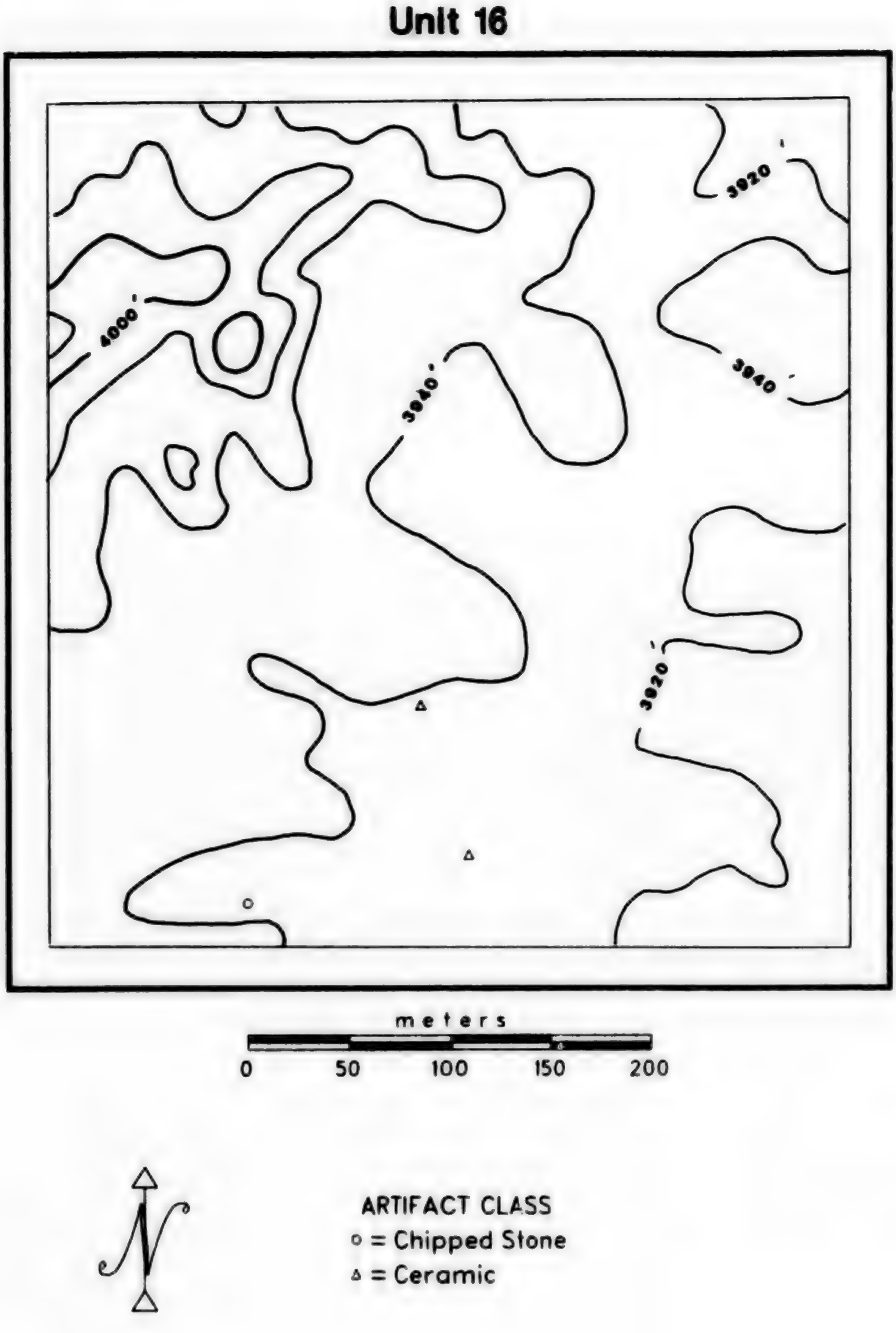


FIGURE 4.9.
ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 16, SURVEY AREA 1.

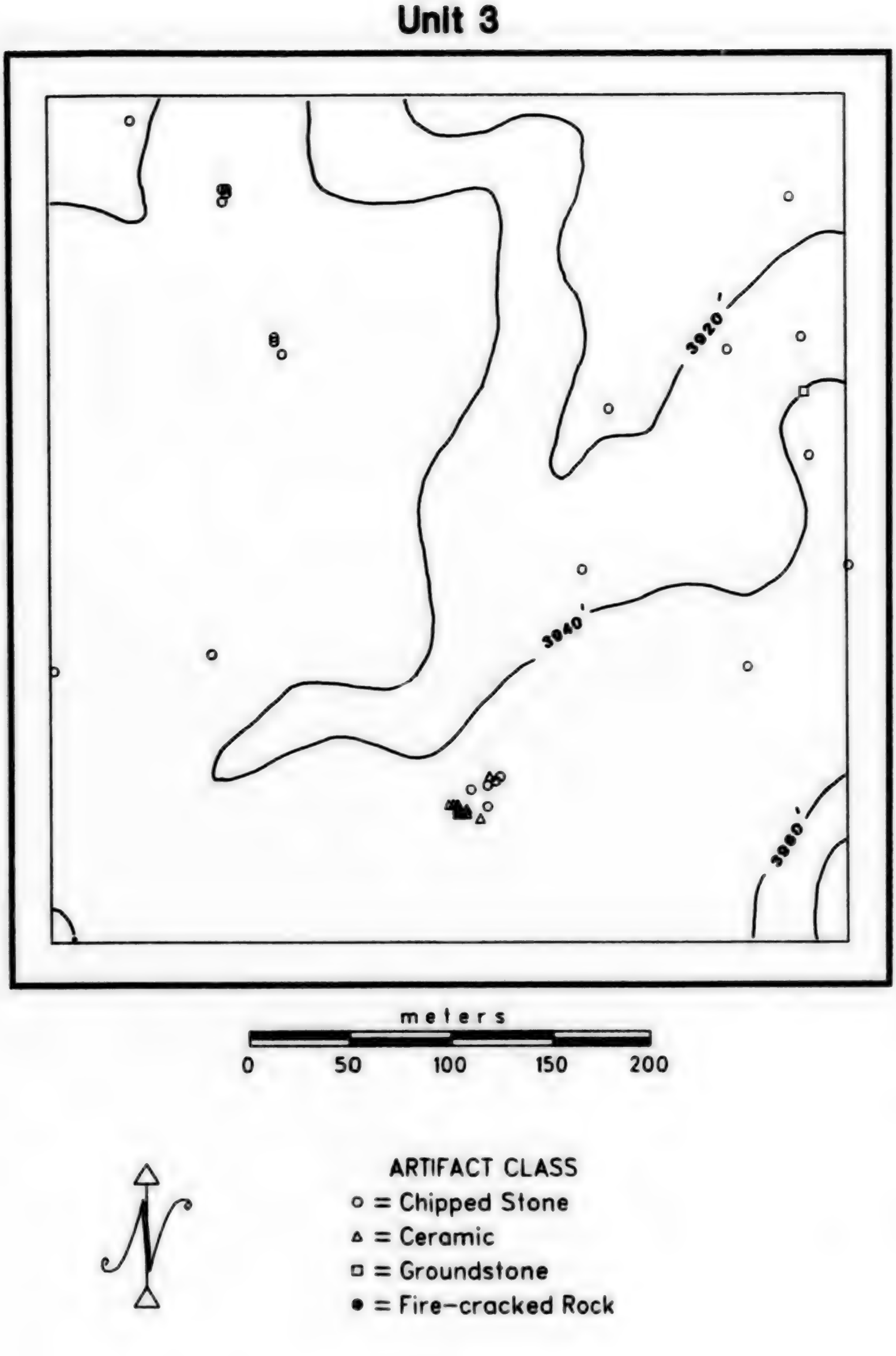


FIGURE 4.10.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 3, SURVEY AREA 2.

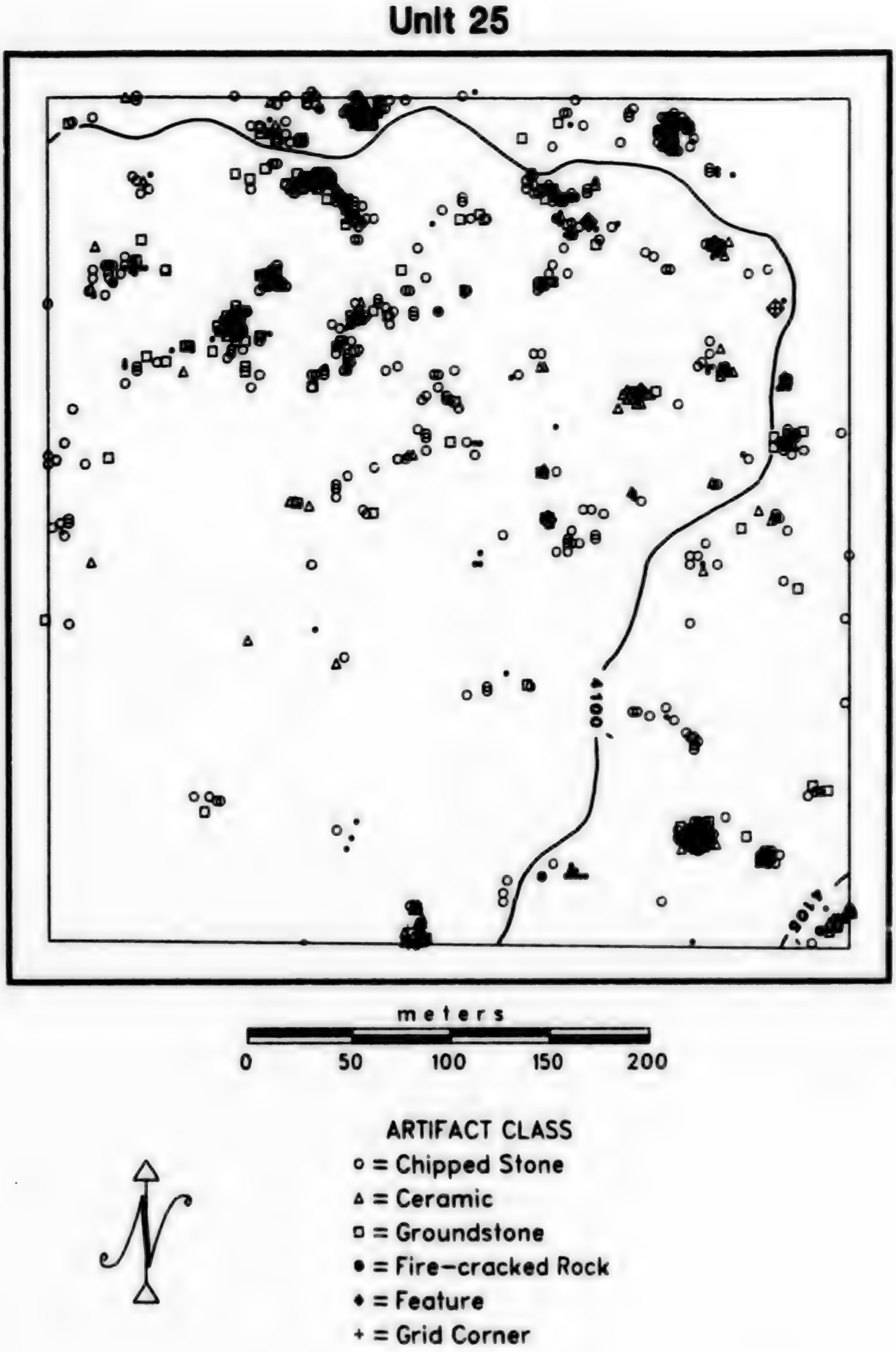


FIGURE 4.11.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 25, SURVEY AREA 2.

Unit 32

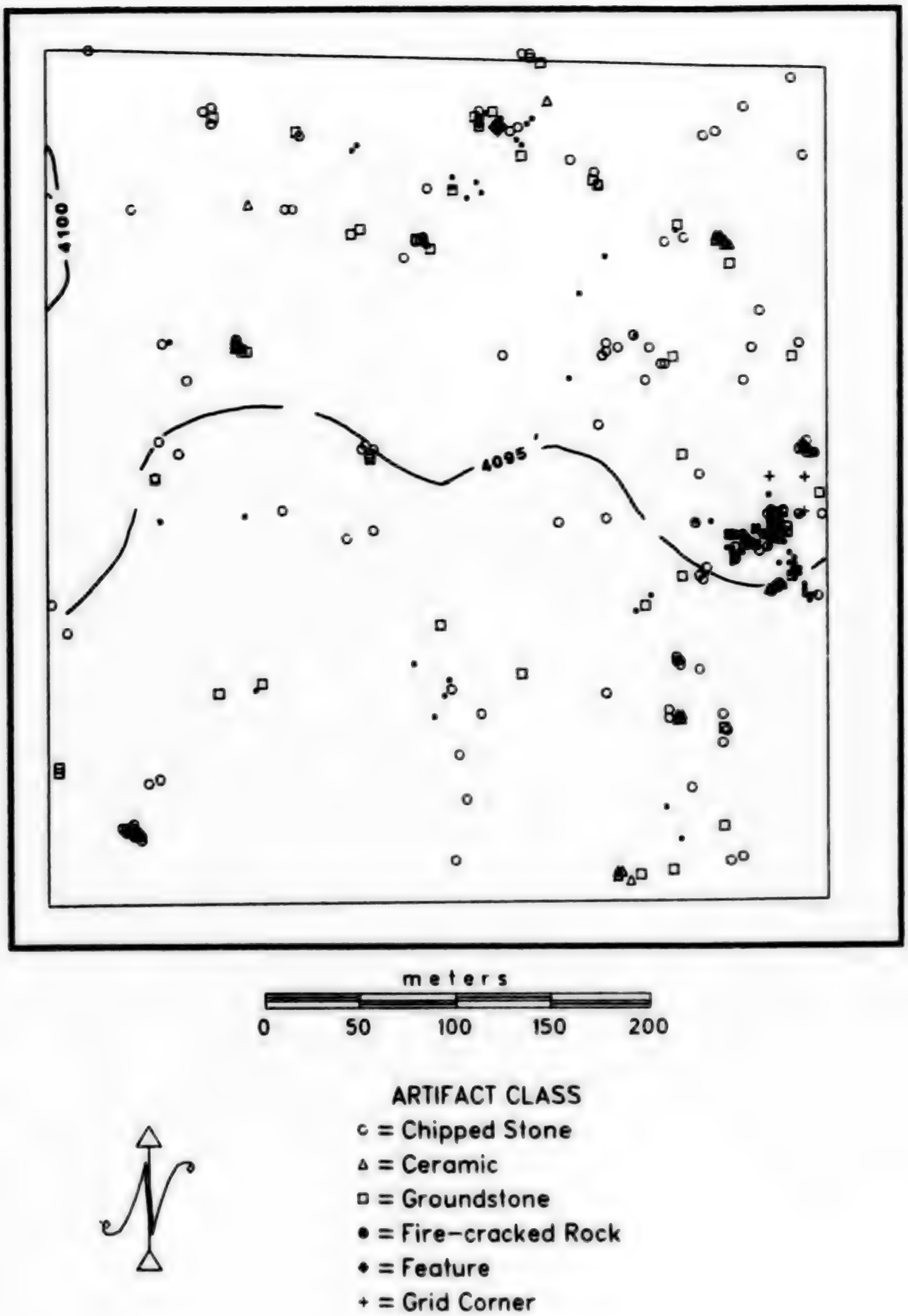


FIGURE 4.12.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 32, SURVEY AREA 2.

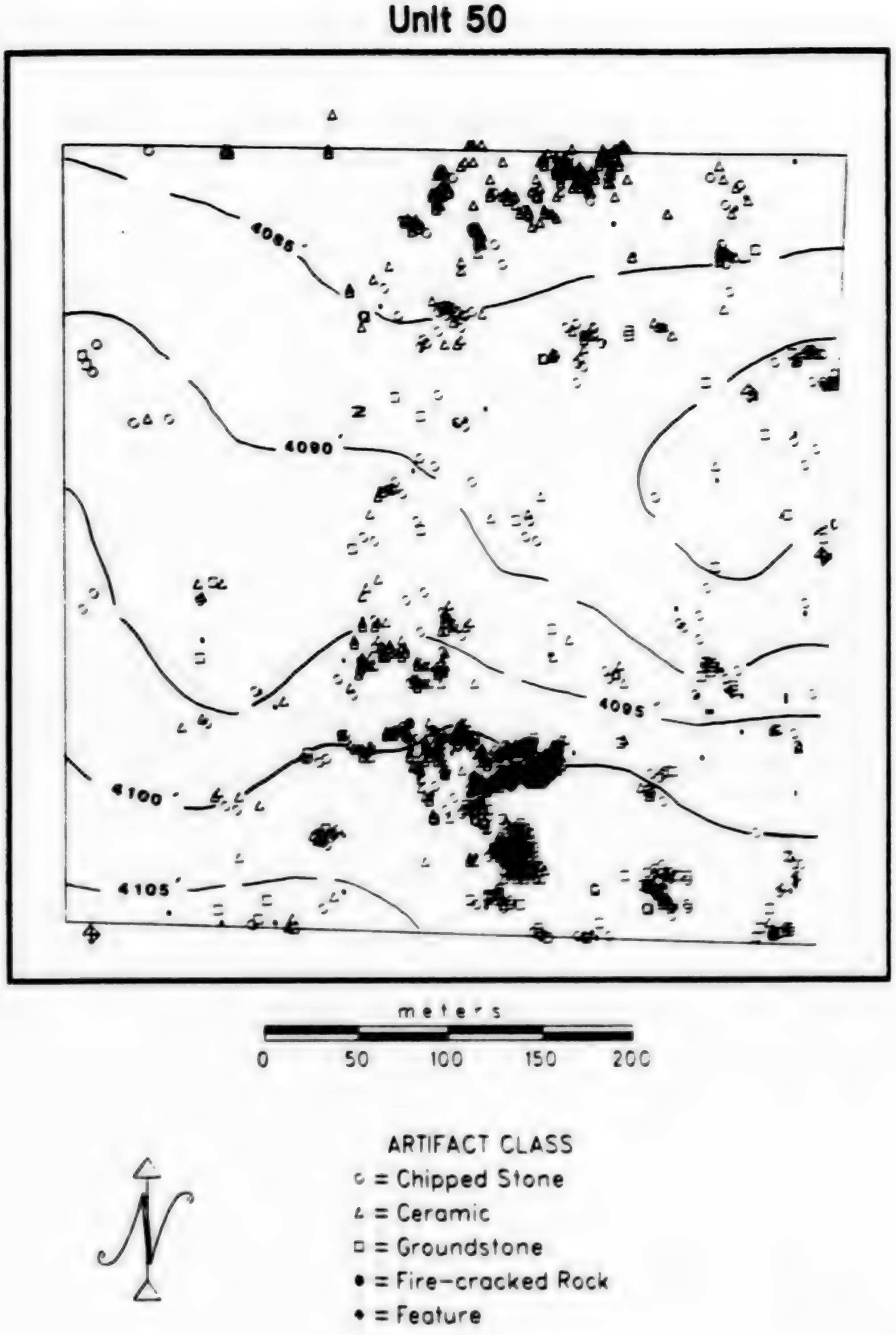


FIGURE 4.13.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 50, SURVEY AREA 2.

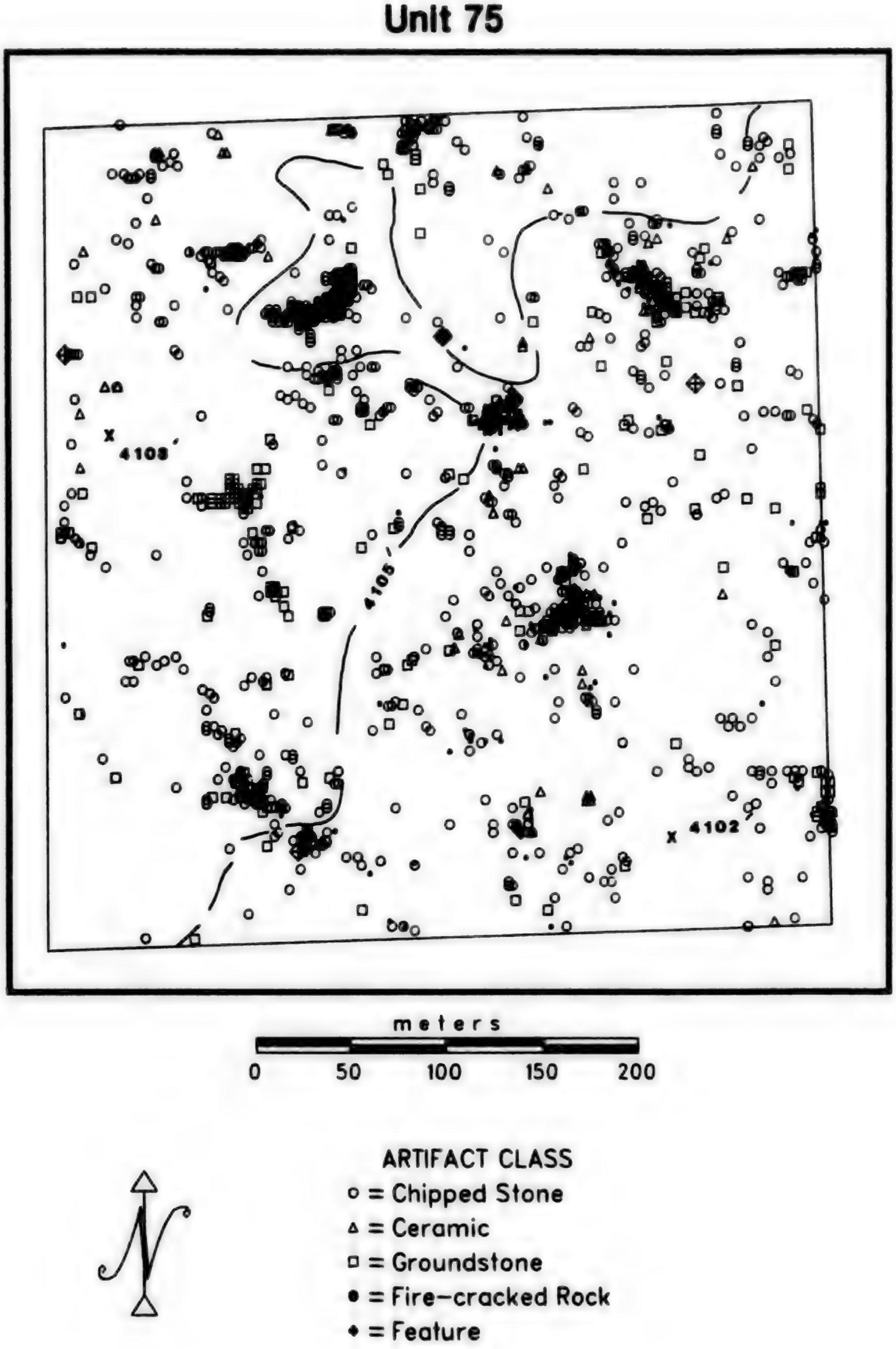


FIGURE 4.14.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 75, SURVEY AREA 2.

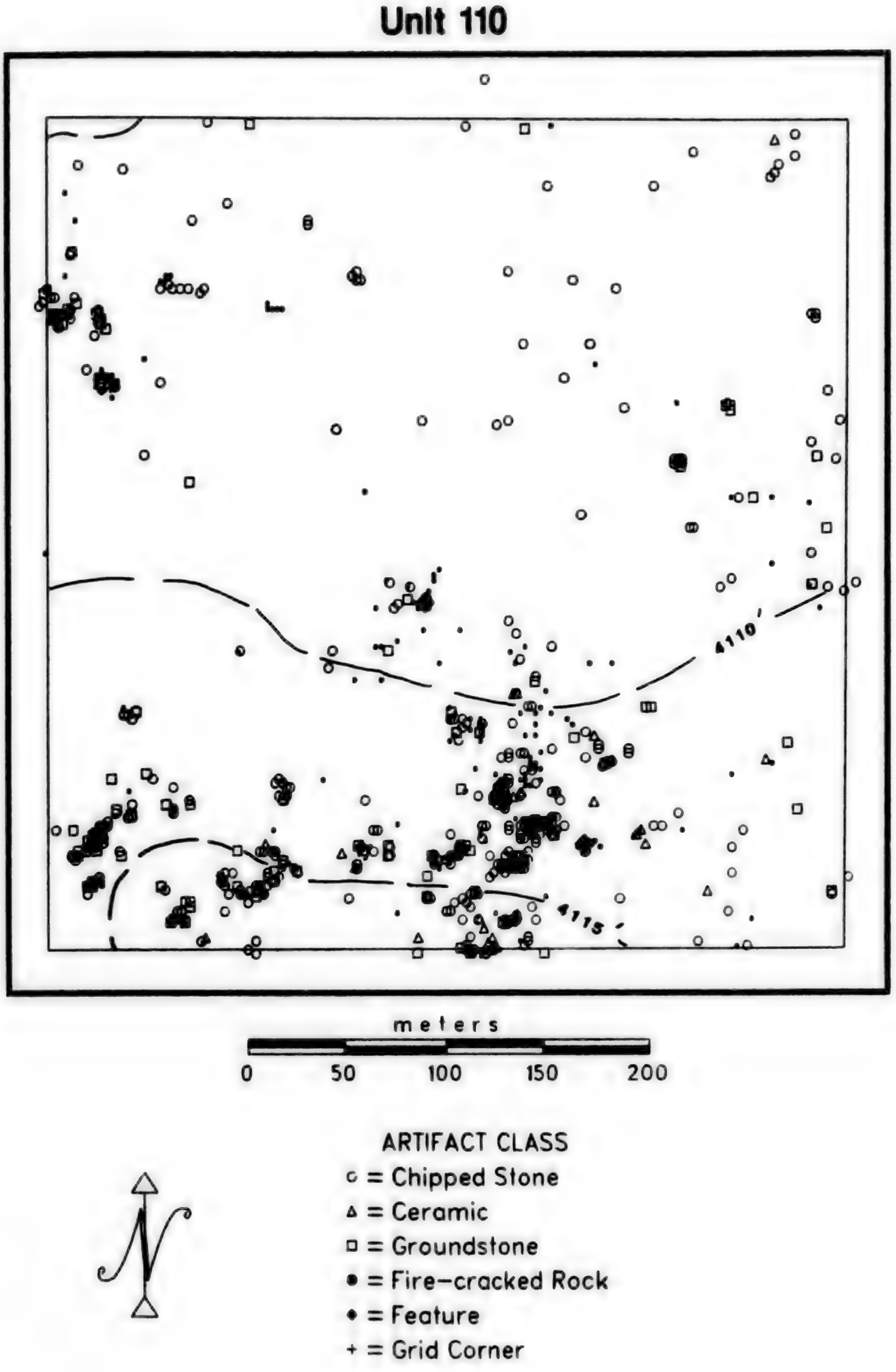


FIGURE 4.15.
ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 110, SURVEY AREA 2.

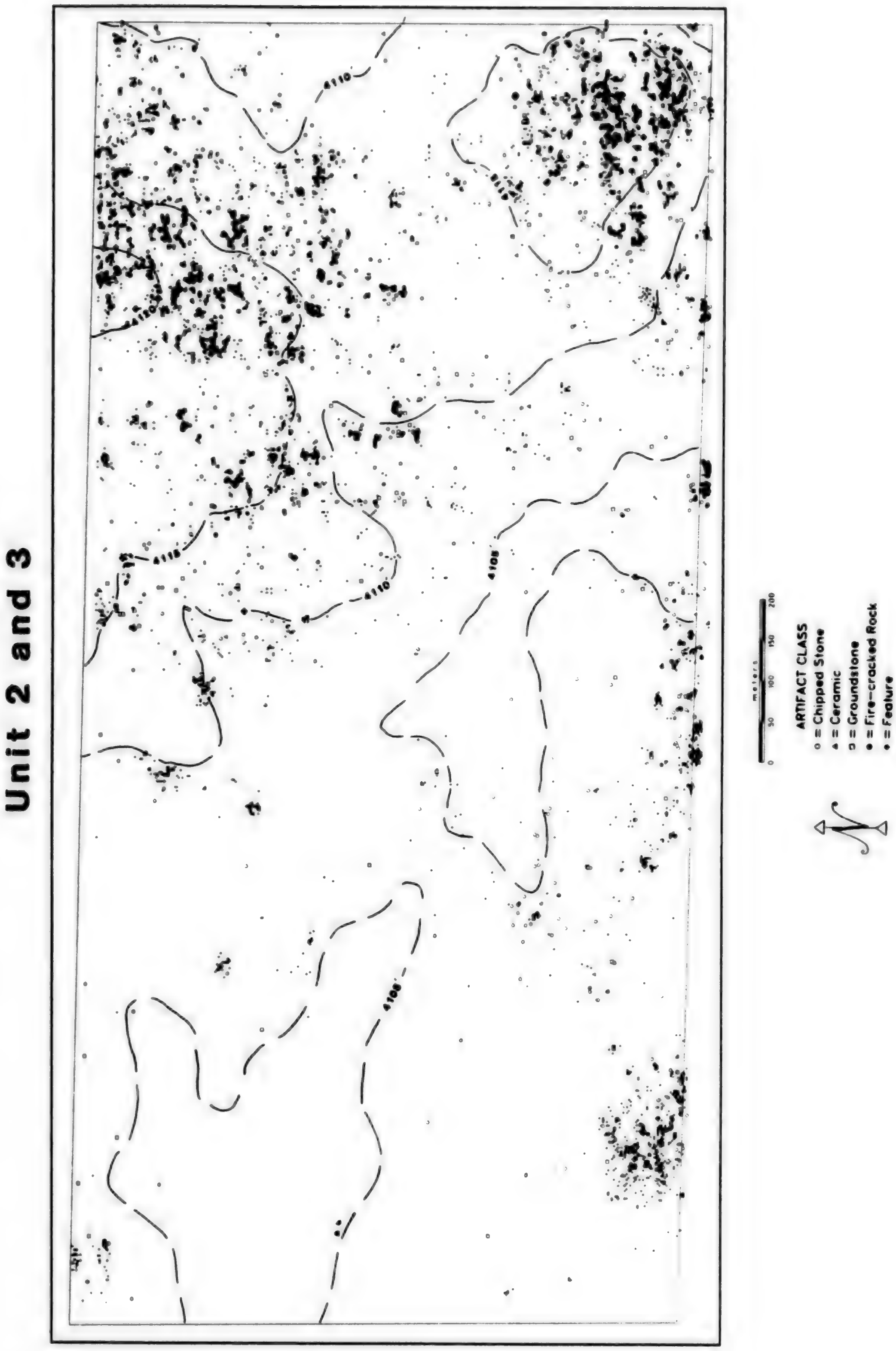


FIGURE 4.16.
ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNITS 2 AND 3, SURVEY AREA 3.

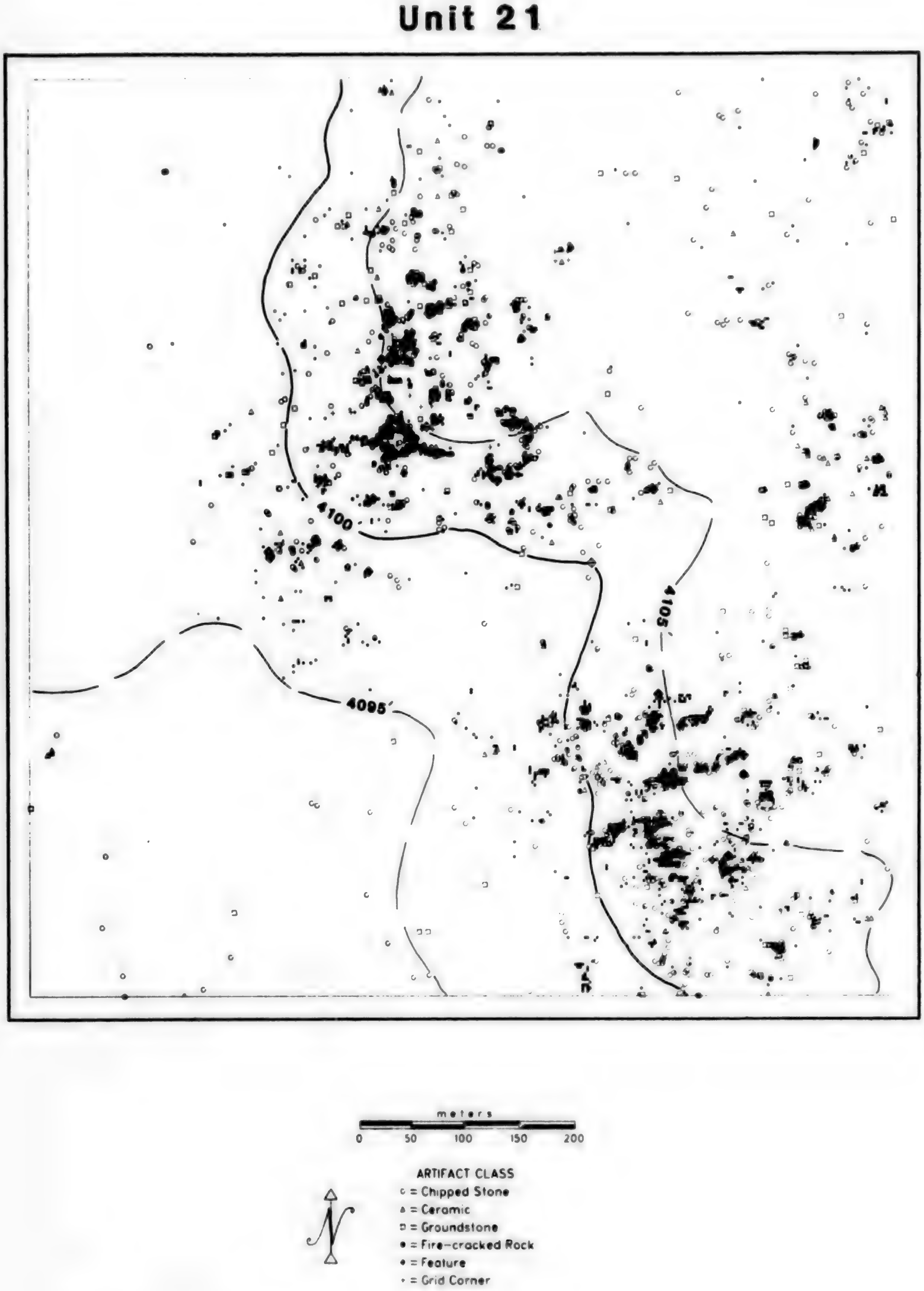


FIGURE 4.17.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 21, SURVEY AREA 3.

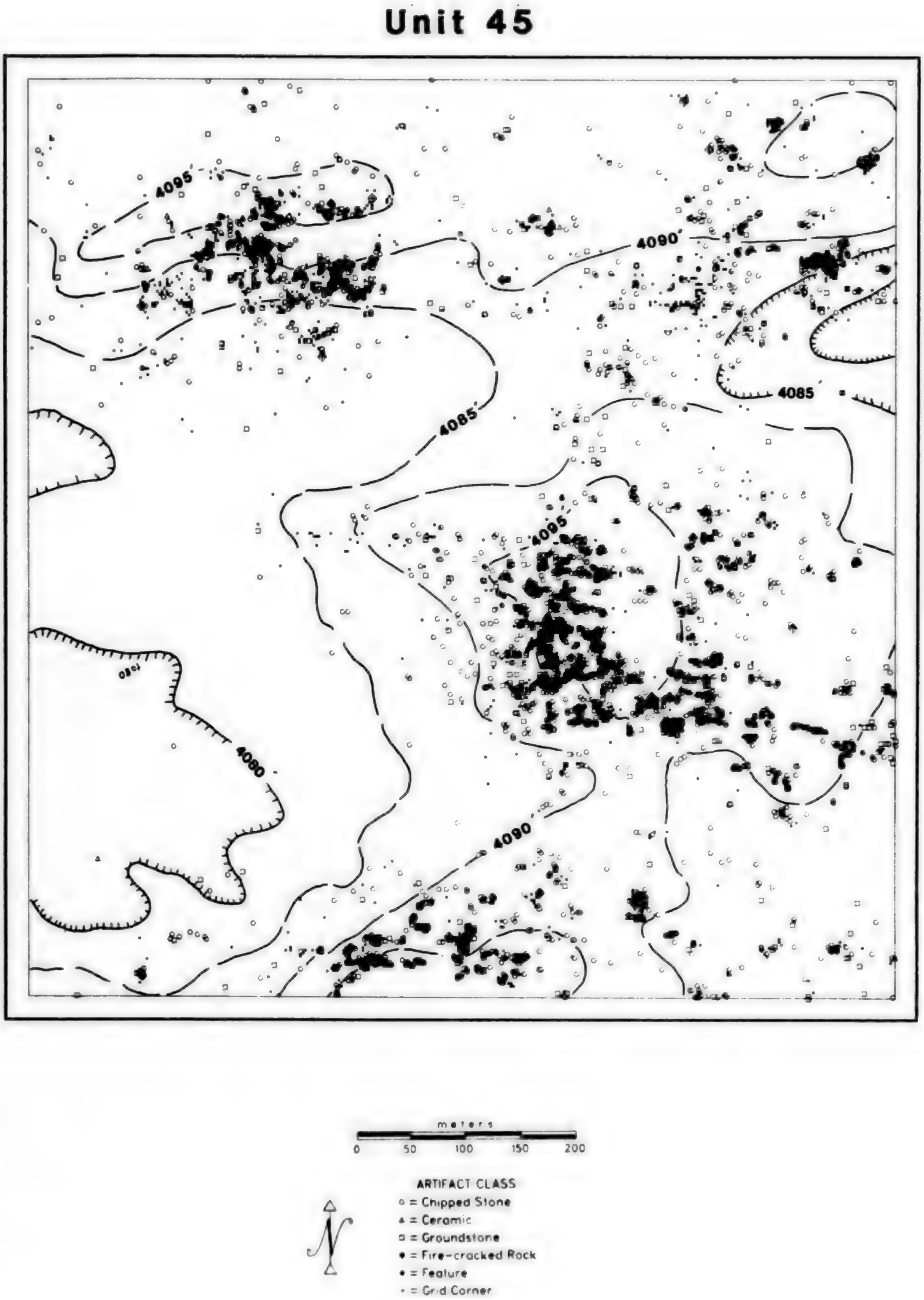


FIGURE 4.18.

ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 45, SURVEY AREA 3.

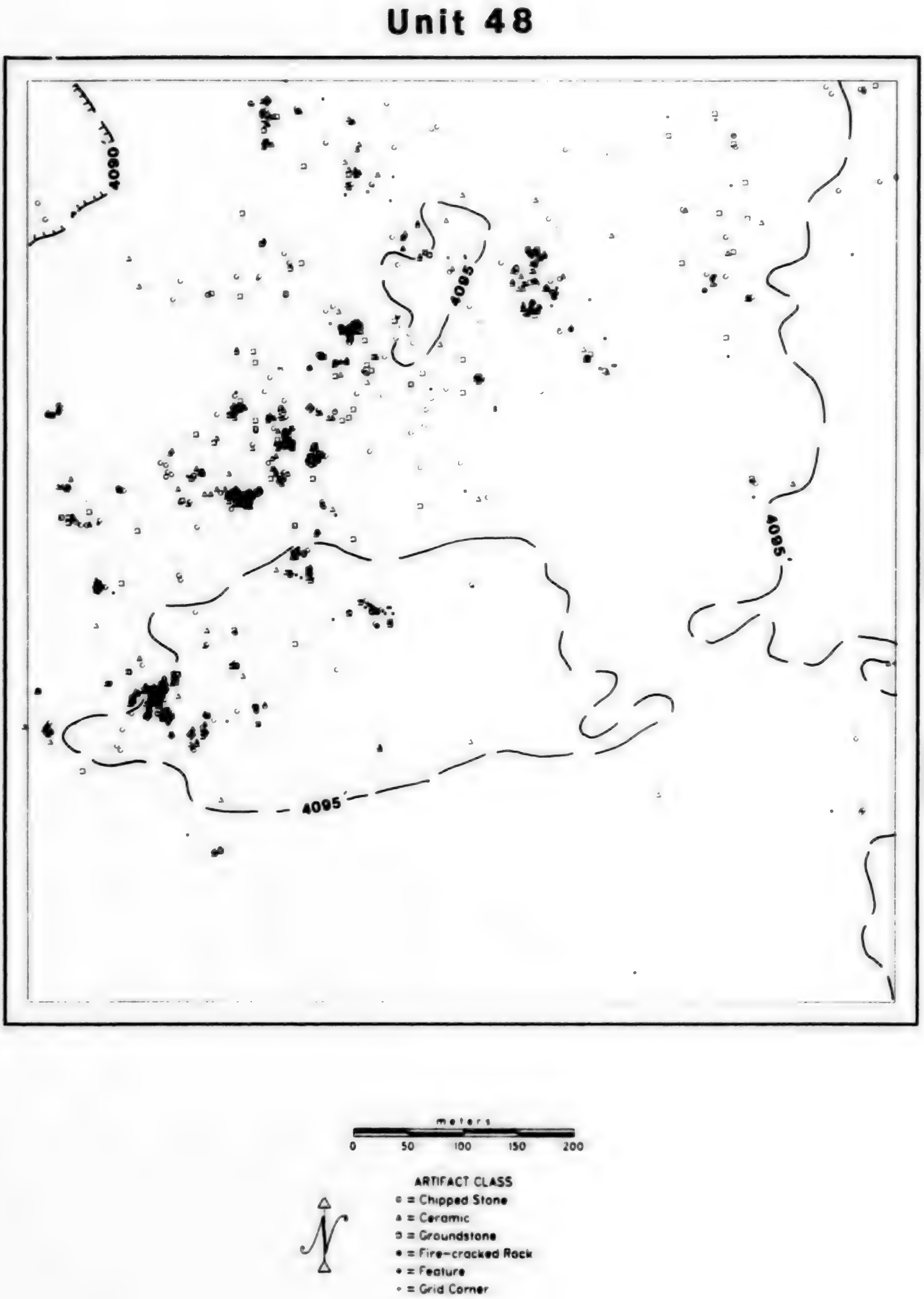


FIGURE 4.19.
ARTIFACT DISTRIBUTION AND TOPOGRAPHY IN SURVEY UNIT 48, SURVEY AREA 3.

Zone. In Areas 1 and 2, these include Units 3 and 16. Unit 1 which straddles the West Mesa scarp lacks archaeological materials in areas lying below (east of) the scarp (Figures 4.8 - 4.10).

2. Low-lying areas and deflation hollows containing deep sand cover are uniformly lacking in abundant surface remains. In contrast, a high degree of interdunal deflation and elevated landforms correspond to higher archaeological densities. Interdunal deflations on the slopes and crests of low hills and ridges in Units 3, 21, and 45 correspond to pockets of high artifact density on the surfaces of these landforms (Figures 4.16 - 4.18). Interdunal deflations on slopes bordering deflation basins in Units 2 and 50 contain similar high densities (Figures 4.13 and 4.16).

3. Surface-cover on Zone 3, an expanse of overlain parabolic dunes described in Chapter 2 of this report, in survey Unit 48 is readily apparent in southern and southeastern portions of this unit as areas of extremely low density (Figure 4.19). Central portions of Unit 110 contain similar sand cover lacking interdunal deflations (Figure 4.15).

4. Units lacking more than 10 feet of topographic relief and a low degree of interdunal deflation are characterized by evenly distributed materials at relatively low densities. These include Units 32, and portions of Units 25 and 110 (Figures 4.11. 4.12 and 4.15).

5. Widespread interdunal deflations measuring between 20 and 30 meters in maximum dimension in Unit 75 and portions of Units 25 where relief is less than 5 feet between unit borders exhibit moderately high densities of surface materials (Figures 4.11 and 4.14).

Comparison of Phase I, Phase II, and Conventional Survey Results

This section compares Phase I and Phase II survey results to those of a conventional site survey conducted in Area 2. First, artifacts tallied during the Phase I transect survey are compared to those inventoried by the Phase II intensive survey of the same survey units. Given the comparison of artifact frequencies encountered during the Phase I transect survey and their relationship to artifact counts obtained with a more intensive survey, artifact counts obtained through conventional survey techniques are evaluated.

The Phase I transect survey inventoried artifacts from an 8 percent of the ground surface in Areas 1 and 2 (4 percent in Area 3). This figure assumes each surveyor tallied artifacts from a 2 meter wide swath and that 6,400 LTMs were walked in each 400 x 400 meter survey unit. To see how this coverage compares with the results of the Phase II intensive survey, ceramic and lithic counts recorded during each phase are listed in Table 4.13. FAR counts are not compared since all individual pieces of FAR were not counted during Phase I.

Because of terrain unevenness, vegetation cover, shadows thrown by vegetation or the surveyors themselves, artifacts are differentially visible and therefore discoverable. Artifacts are not necessarily evenly distributed across the ground surface and high artifactual densities may occur in localized areas. Therefore, it is likely that even the most systematically organized transecting efforts will result in the discovery of more clustered items than of the sparsely distributed ones. As a result, an 8 percent coverage could quite expectably result in the discovery of less than 8 percent of the total item inventory.

Using the Phase II lithic and ceramic inventory as the "known universe" in this case, the effectiveness of the Phase I transect survey can be gauged. In Table 4.13, Phase I artifact counts tallied for each survey unit are listed first, followed by the Phase I count multiplied by a factor of 12.5 to bring the Phase I count up to the equivalent of 100 percent coverage with Phase I survey techniques. Phase I counts from Area 3 survey units, where 4 percent of the surface was transected during Phase I, were multiplied by a factor of 25. The total number of Phase II artifacts were compared to this projected frequency and the multiplication factor needed to adjust Phase I projections to Phase II counts calculated and listed in the last column of the table.

As can be seen, most projected Phase I counts must be multiplied by a factor of two or more to achieve the artifact frequencies in Phase II

Table 4.13. Comparisons of Phase I and Phase II artifact counts.

Unit	Phase I Count	Adjusted Phase I Count	Phase II Count	X or - Division Factor
Areas 1 and 2 (Mesa top only)				
1	12	150	252	X 1.68
25	100	1,250	1,412	X 1.13
32	11	137.50	471	X 3.42
50	79	987.5	1,913	X 1.93
75	70	875	1,726	X 1.97
110	17	272.5	733	X 2.69
Area 3				
2	9	225	392	X 1.74
3	184	4,600	4,229	X 0.91
21	53	1,325	3,229	X 2.44
45	65	1,625	6,185	X 3.80
48	91	2,275	1,672	X 0.73

inventories. For survey Units 3 and 48, units with relatively high ceramic frequencies, however, the projected Phase II counts are slightly higher than those of the Phase II frequencies. This difference may be due to the effects of artifact clustering in these two units. That is, clustered ceramics discovered during Phase I inflate the projected artifact tallies. Figure 4.20 illustrates a regular relationship between Phase I and Phase II ceramic counts. The relationship between lithic counts is regular as well, but the shape of the curve differs between Areas 1 and 2 and Area 3. Relationships between Phase I and Phase II groundstone counts are also regular for most units with the exception of Unit 45 where clustered groundstone may not have been encountered during Phase I but contributes high frequencies of items to Phase II counts.

This comparison establishes the fact that Phase I inventories generally tally items at or below the percentage of the amount of surface inspected. An important implication of this comparison for prediction from samples is that the spatial structure of the distribution may be conditioning sample frequencies to a great extent. To accurately assess the predictive value of Phase I counts, the structure of the distributions that are sampled must be known; and, of course they are not known. This implication will not be pursued here, but it is simply noted that item clusteredness may play a large role in alerting surveyors to the presence of other artifacts and once higher densities of items are encountered in alerting other surveyors to the presence of artifacts; thus, allowing for overestimates of some items. Conversely, if clustered items go undiscovered during survey, frequencies are underestimated. Chapter 5 explores some of the relationships between artifact discovery rate and distribution densities.

In answering the question, how Phase I and II recovery rates compare with intensive conventional survey coverage of the same areas, the survey results for five 40-acre parcels surveyed by Taylor (1981) can be examined. Taylor (1981) recorded two sites and numerous isolates and provides a nearly exact item count for five survey units in Area 2 that are equivalent to Phase I and II survey units. Taylor and sometimes one other person walked 30 meters apart back and forth across these units.

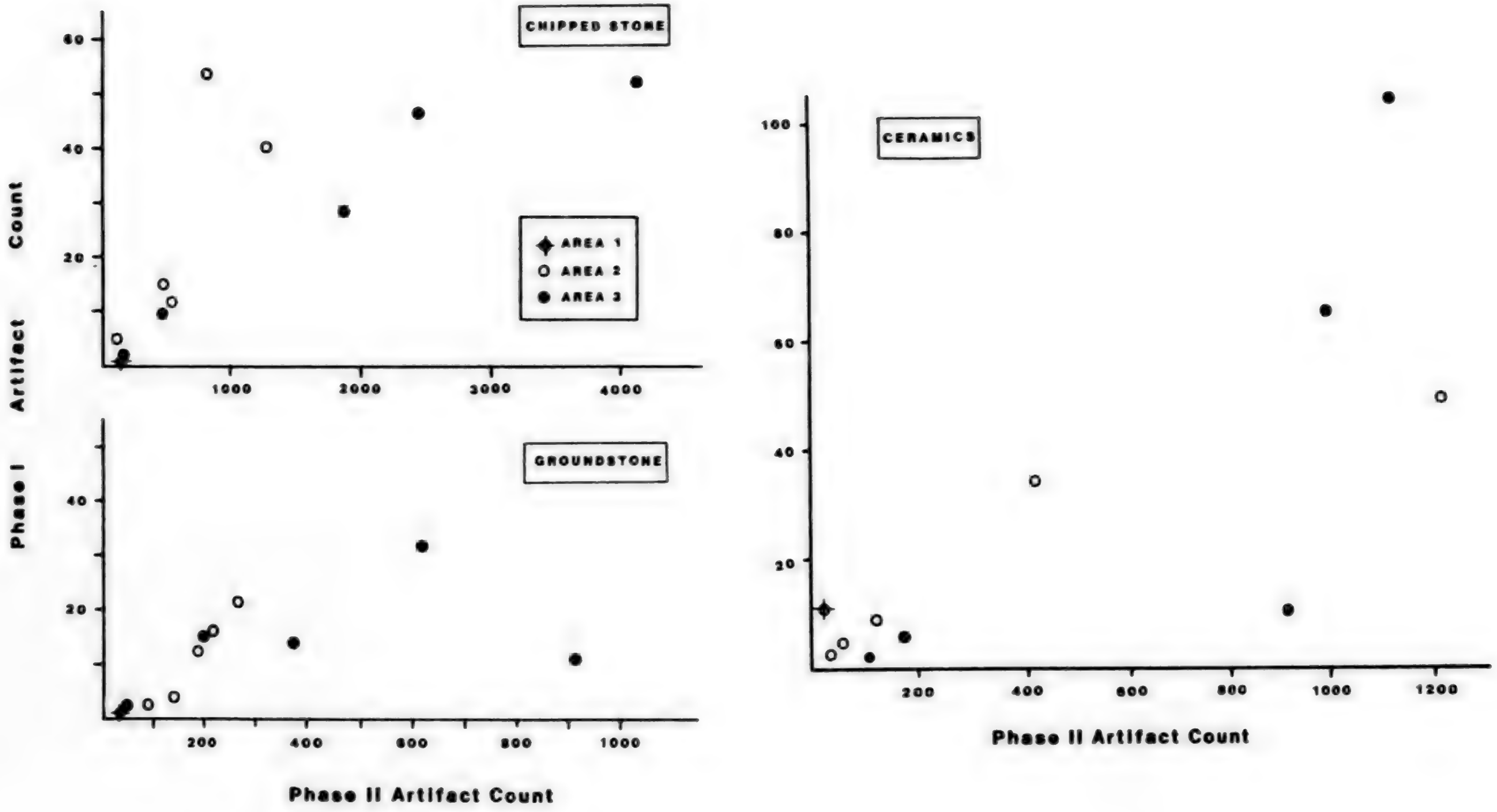


FIGURE 4.20.
RELATIONSHIPS BETWEEN PHASE I AND PHASE II ARTIFACT COUNTS.

This survey is described as intensive with aerial photographs used to plot individual artifacts in sites, isolated and site boundaries. Fourteen transects were walked in each quadrant surveyed. While no surveyor will admit to having found all the surface material in an area, an intensive survey like this one is believed to inventory a good deal of the archaeological materials on a surface. Although no definitions were given for sites and isolates, sites contain as few as seven items, indicating that Taylor (1981:3) was attempting to discover and record the surface archaeology in great detail:

> ...photographers were of such a scale that the surveyor(s) could actually read the photo bush by bush in the field and known his exact location in order to insure that a quadrant was surveyed completely and to locate the precise location of any cultural resources observed.

Without taking "zigzagging" into account, and assuming a 3 meter visibility range on either side of a surveyor, quadrants surveyed by Taylor received about 10 percent survey coverage, or possibly higher, at the interval walked. This coverage is roughly equivalent to that obtained with the Phase I survey which is 8 percent.

Table 4.14 compares artifact counts combining those from sites and isolated items in the conventionally surveyed units with those from Phase I units. Taylor's maps and photos indicate that his survey units and the Phase II units are in nearly the same location. As can be seen, only quadrant Q4 containing a site located inside and outside of this survey unit has higher artifact frequencies than those obtained through a Phase I survey. With this exception, Phase I and conventional counts are relatively similar. However, projecting the Phase I count to a Phase II level (multiply the count by 12.5 and then again by a factor of 2), one can see that artifact frequencies documented through conventional methods grossly underestimate the amount of cultural material in an area.

While one could argue that this comparison is not conclusive evidence for the inability of conventional survey methods to adequately characterize an archaeological surface, it certainly suggests much material may go largely undiscovered with conventional transecting methods which employ widely spaced surveyors. Variability in the discovery rates of artifacts by individual surveyors participating in the Phase II intensive survey will be examined in Chapter 5.

Spatial Associations in Phase II Survey Units

To conclude this chapter, the artifact and locational data inventoried by the Phase II survey are used to devise spatial associations or clusters of items which can be compared as analytical units for artifact content, size, and density in the following chapters of this report. Devising spatial associations relied on a procedure which grouped the x and y spatial coordinates of items. There are many clustering algorithms for clustering either variables or observations. Creating groups of things in space with a data base of over 40,000 observations can prove to be very expensive as large matrices must be manipulated by a computer. Since the data were in a Statistical Analysis System (SAS Institute Inc. 1982) data set, and SAS offered inexpensive and well-supported clustering algorithms, the SAS procedure FASTCLUS was selected as the means to derive analytical units.

FASTCLUS (SAS Institute Inc. 1982: 433-448) finds disjoint (as opposed to hierarchical) clusters (up to 250), can deal with very large data bases on the order of 100,000 observations, and is very good at finding outliers or clusters with a single member which might be similar to archaeological isolated occurrences. FASTCLUS works by selecting seed values of variables and then making each observation a member of the cluster with the closest seed value. The cluster seeds, the total number of which must be specified by the user, are selected from the input observations and were specified to be at least 20 meters from all other seeds. Euclidean distance between observation and seed is used to assess proximity. The cluster seed is then replaced by the mean of the cluster members. When another cluster seed at least 20 meters from the others cannot be found, the clustering halts even if the specified maximum number of clusters has not been found. In the case of the procedure used here, the clustering was allowed to continue using the x and y coordinates in each survey unit until clusters of one were obtained at which time the procedure was halted.

Table 4.14. Comparisons of conventional survey data with artifact frequencies documented through Phase I and II techniques.

SURVEY UNIT	NO IO'S	NO SITES	CONVENTIONAL ARTIFACT COUNTS	PHASE I ARTIFACT COUNTS	PROJECTED PHASE II COUNTS
03	12	1	30	32	800
Q4	22	1	270+	63	1,575
Q6	9		12	2	50
Q7	30		53	40	1,000
Q8	12		24	58	1,450

Determination of Area

There are several ways in which area can be objectively derived from the x y coordinates of the members of clusters including: (1) using different algorithms to describe shape and (2) using different axis values in the selected algorithm. For example, maximum x differences and y differences (where the difference would be the maximum minus the minimum) could be fed into a simple area of the rectangle equation (AREA = LENGTH * WIDTH). These two specifications together would seem to produce clusters of area larger than might be recorded by surveyors in the field. Conversely, the standard deviation of both x and y about their respective means could be used as parameters in an equation for the area of an oval (AREA = (LENGTH + WIDTH / 4) * PI). This specification would result in relatively smaller cluster areas then might be recorded in the field (if the total extent of the artifacts is what people actually do record in the field), although the oval shape seems more truthful to the actual shapes of many artifact distributions.

Parameters perhaps more comparable with what the field archaeologist records (a combination of total extent of the distribution and changes in density of the distribution) are derived from the range of x and y coordinates occurring between the 75 percentile and the 25 percentile. The x axis then, is the x value at 75th percentile minus the x value at the 25th percentile; similarly for the y axis. These estimates were then included in formula for the derivation of the area of an oval.

To the eye, this seems a palatable way of objectively assessing area. There are cases, however, where seemingly bizarre area values are recorded: (1) when the distribution is oddly or irregularly shaped (e.g. horseshoe shaped) and (2) when the distribution has a very high concentration of artifacts which overwhelm the contribution made by the more dispersed members of the cluster. It is our impression that these are rare occurrences and that for the most part the derived area values are good approximations for the area a field archaeologist might record for the same distribution in the field.

In all, 1796 spatial clusters of artifact and features were obtained with the above described procedures. Only items in mesa top survey units were clustered with items in survey Units 2 and 3, adjacent units forming a 1600 x 800 piece-plotted surface, clustered together. Table 4.15 lists summary statistics on spatial clusters in survey units. In the following sections of this report, spatial clusters of artifacts and features are used as analytical units among which to compare lithic, ceramic, and feature contents.

[illegible] spatial associations of artifacts and features on the West Mesa Surface probably represent composites of debris from multiple activities and occupations, some widely separated in time. Typically, spatial aggregates of artifacts are termed sites, and are interpreted as resulting from monofunctional and temporally discrete prehistoric activities. In this study, objectively defined concentrations of artifacts must be compared with previously collected site data. Thus, while acknowledging a potential lack of behavioral integrity of spatially aggregated materials, it is for reasons of comparability that this analysis identifies spatial concentrations.

Table 4.15 Summary statistics of spatial cluster attributes by unit.

SURVEY UNIT	N CLUSTERS	PERCENT FAR	 GRSTN	 CERAM	 LITHIC	MEAN NO FEATURES	MEAN N	MEAN AREA	MEAN DENSITY
Areas 1 and 2									
1	84	79.29	3.16	1.98	15.55	0.17	20.02	52.53	1.78
25	74	18.29	13.05	12.15	56.49	0.08	22.43	48.22	2.05
32	48	26.93	18.45	8.29	46.30	0.02	14.25	42.05	2.10
50	92	15.42	13.29	41.30	29.97	0.06	22.65	48.86	3.39
75	128	9.83	14.47	7.40	68.28	0.07	15.92	62.98	11.34
110	75	28.48	13.95	4.06	53.49	0.05	16.84	43.31	12.75
Area 3									
2+3	551	68.41	4.66	6.38	20.53	0.06	24.93	48.84	6.06
21	279	50.44	8.77	9.84	30.94	0.10	22.79	44.37	5.22
45	345	37.13	12.58	1.50	48.77	0.12	23.54	52.28	0.19
48	120	16.13	15.39	32.69	35.77	0.10	15.28	40.98	21.02

CHAPTER 5

AN ASSESSMENT OF THE SPATIAL ACCURACY AND DESCRIPTIVE PRECISION OF THE DISTRIBUTIONAL DATA BASE

The Navajo-Hopi Land Exchange Project (NHLEP) data base consists of some 40,000 items for which location and description are available. Within this data base, there is a tremendous amount of variability, to which succeeding analyses testify. How much of this variability can be attributed to variability in the use of the landscape through time (as manifested in differential discard and loss) and how much is due to the procedures actually employed in documenting the surface archaeology of the NHLEP area.

In this chapter, the accuracy and precision of procedures used to record this surface archaeology is evaluated through an investigation of the nature of trends within the data base. Accuracy refers to how well a sample of a population represents that population. In this case, the concern is centered on how accurately the post-survey picture of the archaeological surface, contained in the data base, represents the potential archaeological distribution actually on the surface at the time of the survey. The term bias refers to the difference between what is actually discovered and recorded, and what is "really out there" (see Cowgill 1975 for a discussion of these terms). In sampling, precision refers to how similar or different one sample is when compared to multiple independent samples of the same phenomenon, and thus is a measure of how reliable or consistent the sampling procedure is. For the NHLEP data base, the interest is in learning whether the discovery procedure produces the same amount and kind of accuracy or inaccuracy when applied to different units. To make this assessment, one would need to know the location of all artifacts on the surface of every unit surveyed and compare this "truth" with a sample. But, there wasn't a complete inventory of all artifacts lying on the surface of, e.g., Unit 75 on March 31, 1985 when it was surveyed, so the accuracy of the discovery procedure could not be assessed. However, because of the design of the procedures for documenting the surface archaeology, multiple nonindependent passes are made through each survey unit and, thus, discovery accuracy can be investigated through a consideration of the sorts of artifacts that are recovered with each pass. Discovery precision could be evaluated by considering variability among units in artifact discovery.

An assessment will be made, however, of the procedures used in describing chipped stone attributes. Because all aspects of chipped stone analysis are to some degree subjective and description of artifact attributes is by convention, this discussion will not be concerned with the accuracy of the artifact coding procedure. Instead, the concern will be with the precision of the description procedure, specifically, how consistently the coding conventions were applied by coders with different amounts of experience and familiarity with the chipped stone coding scheme.

Note that the term archaeological record has been used in a very specialized manner to refer to the document of an archaeological surface which the archaeologist brings back from the field. This is different from its common usage in which archaeological record means the material fallout of a prehistoric cultural system.

DISCOVERY ACCURACY

Some research has been done by archaeologists on the nature and representativeness of the archaeological record with which they return from the field. Four different sorts of factors that influence the archaeological record are recognized: (1) attributes of the surface archaeological deposit or the potential archaeological record, (2) environmental conditions under which the survey is conducted, (3) survey concepts and procedures, and (4) characteristics of the surveyors themselves. Schiffer and others (1978) consider the first two types to be factors over which the archaeologist has little control, while, according to them, types 3 and 4 can be controlled for with due care.

Factors of the first type include characteristics of the surface archaeological deposit like site (or artifact) abundance, clustering, and obtrusiveness. As discussed by Schiffer and

113

others (1978), if artifact or site frequency is high or if artifacts or sites are not highly clustered, then the character of the archaeological record may be accurately and precisely measured even with a small sample. As abundance falls, or archaeological remains become more clustered, sample survey becomes a less reliable way of assessing the full character of an archaeological surface distribution since survey within the sample units may or may not encounter archaeological remains. As further discussed by Schiffer and others (1978), the obtrusiveness or conspicuousness of archaeological material also predisposes it to discovery although this may be moderated by both environmental factors of visibility (as influenced by vegetation, sediment) and survey techniques (e.g., shovel testing in heavy duff areas).

An artifact "seeding" program conducted in the course of the Seedskadee Project in southwestern Wyoming provides indications of the effects of these first factors on the archaeological record (Wandsnider and Ebert 1983). The Seedskadee Archaeological Project (Ebert et al. 1983; Wandsnider and Larralde 1984), like the NHLEP project, employed distributional survey techniques. Locations and descriptions of 16,000 artifacts in 25 parcels of land 500 meters on a side were recorded.

One of these units was "seeded", prior to survey, with 202 contemporary artifacts, washers, and nails spray-painted matte black and buff. Two different sorts of distributions were mimicked through seeding: that of "isolated occurrences" and that of "sites" (artifact clusters). Varying shapes and densities of the latter were introduced onto the landscape. In the course of surveying the unit, all encountered artifacts, contemporary and prehistoric, were flagged with orange pinflags. The artifact coding crew later returned to the unit to describe the prehistoric artifacts and flagged any artifacts they discovered in red.

Recovery of the seeded artifacts is summarized in Table 5.1. In general, more of the smaller but more unnaturally shaped washers (70 percent) as opposed to larger (but less unnatural) nails (60 percent) were recovered, more black (71 percent)

Table 5.1. Percent Artifacts Recovered by Crew (after Wandsnider and Ebert 1984).

	Type		Color		Proximity	
Crew	Washers	Nails	Buff	Black	Clustered	Isolated
Discovery	60%	49%	56%	54%	68%	16%
Encoding	10%	11%	5%	17%	12%	6%
Total	70%	60%	61%	71%	80%	22%

than buff (61 percent) artifacts were recovered, and more clustered (80 percent) than isolated (22 percent) artifacts were recovered. As cluster density increased, so did the proportion of artifacts recovered (Spearman's Rank-Order Correlation Coefficient of .905 which is significant at the .01 level). In terms of obtrusiveness, then, black unnaturally-shaped washers are most likely to be found. In terms of clusteredness, the discovery of one artifact appears to pique the attention of the surveyor, so that other nearby artifacts are also found.

The second set of factors relate to environmental conditions under which the survey is conducted. O'Brien and others (1982) find evidence for bias in the recorded density of ceramic sherd densities as modulated by vegetational influences on visibility. In addition to visibility, Schiffer and others (1978) identify accessibility of the survey unit, as constrained by terrain or availability of roads, as a factor which may influence the quality of the archaeological record. Schiffer (1985) discusses some of the gross spatial patterns in the Whallon's Keban Reservoir (Turkey) Survey (Whallon 1979) data which are perhaps attributable to differential access.

The third type of factors, survey concepts and procedures, archaeologists have spilt a great deal of ink over since they, and the biases they lend to the archaeological record, are to some extent within our control. Schiffer and others (1978) and Plog and others (1978) discuss the effect of the parameters of sample survey, including unit size and shape, sampling scheme, stratification, sample size, and survey intensity, on the nature of the resulting archaeological record. They also acknowledge how variously applied definitional criteria for "site" may yield radically different archaeological records, even if the surface remains are identical.

Lastly, characteristics of the surveyors themselves may influence the shape the archaeological record assumes, as discussed by O'Brien and others (1982). They suggest, for example, that the completeness of the archaeological record may be influenced by fieldworker experience and interest, and that each of these attributes will experience both daily and seasonal fluctuations. That is, experience, and the efficiency with which artifacts (in their case, rim sherds), are recovered will increase throughout the field season, but, at the same time, interest may wane. Researchers with the Xoxocotlan Project (O'Brien et al. 1982:127) attempted to minimize the effects of boredom on recovery bias by collecting during the middle of the day, which they suspected to be optimal for surface collection, and to collect for at most a half a day at a time. In their analysis of rim sherd densities with respect to time of survey, O'Brien and others (1982) could detect no evidence of this sort of systematic bias.

Artifact Discovery Accuracy

The NHLEP data base, in that it consists of a large number (40,000) of prehistoric items for which location and detailed descriptions are available, provides a rare opportunity to consider some of the parameters of artifact discovery as discussed above in light of the accuracy of the discovery procedure. On the first pass through the unit, the discovery crew flagged all artifacts in orange. From 1 to 7 days (median of 2 days; see Table 5.2) after discovery, the artifact attribute encoding crew returned to analyze the discovered artifacts and finished this task from 1 to 9 days later. Concomitant with this, encoding crew members engaged in inadvertant resurvey and discovered and analyzed other artifacts which they flagged in red to distinguish them from those found by the discovery crew. Because for most units (Unit 2 being a notable exception), not much time elapsed between discovery and encoding, the orange- and red-flagged artifacts can be considered as two very different samples of the same surface artifact population. By considering those artifacts flagged in orange on the first pass through the unit and comparing these artifacts with the total surface artifact population (both orange and red flagged items; see Chapter 4), taken to be all recorded artifacts, some of the factors which contribute to the archaeological record can be explored.

These are discussed in turn using all units for which artifacts were located to the nearest centimeter (see Table 5.3). Some of the units in which grid proveniencing was practiced, i.e., units for which artifacts were mapped in four or less grids, are also included here, although the

Table 5-2. Dates that units were surveyed and analyzed and the amount of time elapsing between the two.

Unit	Date Surveyed	Date Encoding Began	Date Encoding Ended	Days between Survey and Encoding Start	Days between Survey and Encoding Finish
1	4-11-85	4-12-85	4-13-85	1	2
3	4-04-85	4-04-85	4-04-85	0	0
16	4-18-85	4-18-85	4-18-85	0	0
25	3-28-85	3-28-85	3-31-85	1	3
32	3-19-85	3-20-85	3-20-85	1	1
50	4-24-85	4-25-85	4-27-85	1	3
75	3-31-85	4-01-85	4-04-85	1	4
110	3-21-85	3-27-85	3-28-85	6	7
2NE	12-02-84	1-03-85	1-03-85	31	31
2NW	12-05-84	1-04-85	1-04-85	30	30
2SE	1-07-85	1-08-85	1-08-85	1	1
2SW	12-05-84	1-06-85	1-07-85	31	32
3NE	1-29-85	2-03-85	2-07-85	5	9
3NW*	1-22-85	1-24-85	2-11-85	2	11
3SE	1-09-85	1-18-85	1-18-85	9	15
3SW	1-08-85	1-09-85	1-10-85	1	2
21NE	2-07-85	2-14-85	2-6-85	7	9
21NW	2-08-85	2-18-85	2-19-85	5	11
21SE	2-16-85	2-19-85	2-21-85	3	5
21SW	2-15-85	2-18-85	2-19-85	3	4
45NE	3-13-85	3-13-85	3-16-85	1	3
45NW	3-15-85	3-17-85	3-18-85	2	3
45SE	2-27-85	2-28-85	3-04-85	7	11
45SW	2-21-85	2-27-85	3-01-85	6	8
48NE	3-16-85	3-18-86	3-18-86	2	2
48NW	3-15-85	3-17-85	3-18-85	2	3
48SE	3-17-85	3-17-85	3-17-85	0	0
48SW	3-14-85	3-18-85	3-19-85	4	5

NOTE: *(Analysis days: 1-24, 1-30/31, 2-2)

Table 5.3. Units and sweeps included in discovery accuracy analysis.

Unit	No. Sweeps Included	Temperature Information
1	13	
3	16	
16	8	
25	15	
32	14	
50	16	
75	16	
110	14	
2NE*	13	missing
2NW*	14	missing
2SE*	15	missing
3SW	16	
21SW	15	missing
45NE	15	
45NW	16	
48NE	16	
48NW	16	
48SE	16	
48SW	16	

NOTE: a/ Except for Unit 16, which was in size half the area of all other units and was surveyed in 8 sweeps, all units were surveyed in 16 sweeps. Temperature information for the day unit was surveyed is available unless otherwise indicated from the Department of Commerce (1985).

*Fire-altered rock data from Unit 2 not included in size and color analyses and no Unit 2 data included in analyses requiring sweep density information.

sweeps which contain the grids are not. All other units containing provenience grids are not included since discovery crew members may have anticipated the gridding, which was done in cases of high artifact density, and may not have flagged as carefully. The criteria for flagging and describing FCR were solidified after the survey of Unit 2 and so Unit 2 FCR are not considered in this analysis. As survey procedure was constant throughout the survey, its effect on the archaeological record cannot be assessed, but each of the other three types of factors are considered.

Attributes of the Archaeological Record

Artifact obtrusiveness, frequency, and local artifact density or clusteredness, may all predispose an artifact to discovery. The characteristics of an artifact which might make it more obtrusive or conspicuous include its size and color relative to the background surface sediments. For chipped stone, length in millimeters was measured for complete flakes, all formal tools, and whole groundstone. A size class (0-30 millimeters, 30-60 millimeters, 60-100 millimeters, and 100 milimeters) was recorded for all artifacts for which metric measurements were not recorded, including chipped stone debris, cores, and fragmentary groundstone. Maximum dimension was recorded for all ceramic sherds and each recorded piece of fire-altered rock (FAR) was assigned to a size class.

Figure 5.1 considers the percentage of orange-flagged artifacts of all recorded artifacts versus artifact size for each artifact class. In general, as size of the object increases, the proportion of artifacts discovered on the first pass, i.e., the orange-flagged artifacts, also increases. When the item frequency is low, as it is for ceramic sherds in the 100-125 milimeter range (Figure 5.1a), chipped stone in the 75-100 and 100-125 milimeter ranges (Figure 5.1b), and groundstone above 40 milimeter in maximum length (Figure 5.1c), the proportion of first-pass discovery items varies between 50 percent and 100 percent.

The proportion of discovered artifacts varies at different velocities between artifact classes. For example, percentage of orange flags for ceramic sherds (Figure 5.1a) seems to increase in a stepped fashion with plateaus at 50 percent, 78 percent, and 89-92 percent. For chipped stone (Figure 5.1), the percentage recovered on the first pass increases more gradually as length increases. When artifact lengths are collapsed into the appropriate size class and added to those artifacts for which only size class information is available, as in Figure 5.2, the resulting graphs again show that as object size increases, so also does the proportion of orange flagged objects. That is, the larger an object, the more likely it is that it will be discovered on the first pass through a survey unit.

Figure 5.3 illustrates and compares the trends in "artifact discoverability" found for each artifact class. Figure 5.3a shows that the chipped stone trend appears to follow that found for ceramic sherds, with chipped stone recovery remaining about 2-10 percentage points beneath that of ceramics for all but the largest length classes. Considering just those length classes with adequate frequencies of items, this difference between the ceramic and chipped stone trends seems to be smallest for the small length classes (10-30 millimeters) and larger for larger length classes, e.g., 30-75 millimeters. Looking to just the size class graph (Figure 5-3b), groundstone closely follows chipped stone, as does FAR for FCR larger than 30 millimeters in size, and these three are quite different from the size class trend for ceramics.

The difference between the ceramic size-discovery relationship on one hand and the size-discovery relationships for chipped stone, groundstone, and FAR on the other hand may relate to the clusteredness inherent to each type of artifact class. That is, it is our impression that sherds more often occur in clusters with other sherds while this is less often the case for the other artifact classes. Another possible reason for this difference may lie in the "unnaturalness" of sherds as opposed to the other artifact classes. The Seedskadee seeding results found that washers, although they were smaller than the seeded concrete nails, were discovered at a slightly higher rate and it was suggested that this may be due to the unnatural roundness of the item (Wandsnider and Ebert 1984). Similarly, we suspect that the unnatural shapes which ceramic sherds typically assume may render them more visible to the eye than even larger-sized examples of groundstone, FAR, and chipped stone,

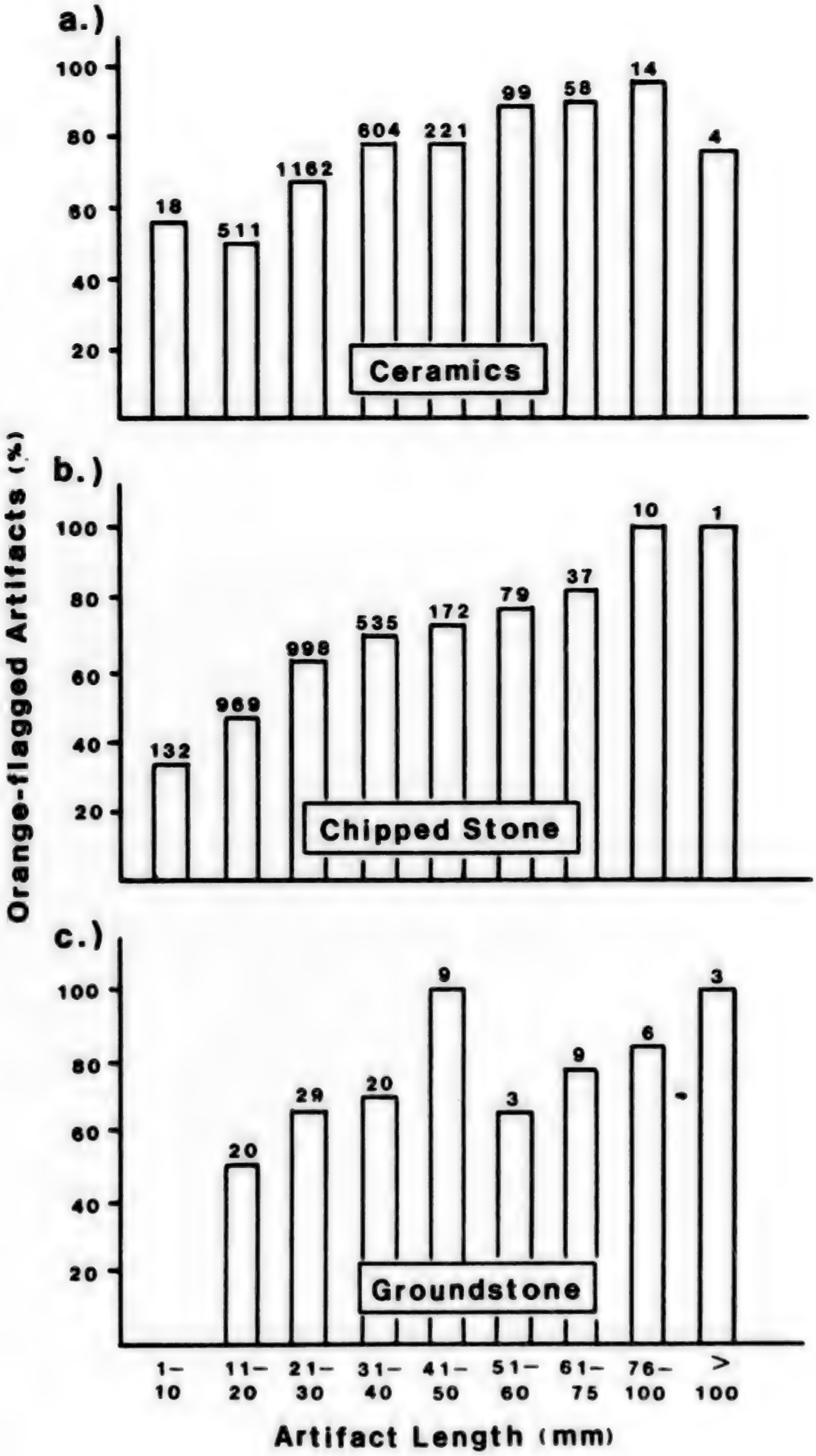


FIGURE 5-1.
PERCENT ARTIFACTS DISCOVERED BY ARTIFACT LENGTH
FOR A) CERAMICS, B) CHIPPED STONE, C) GROUNDSTONE.

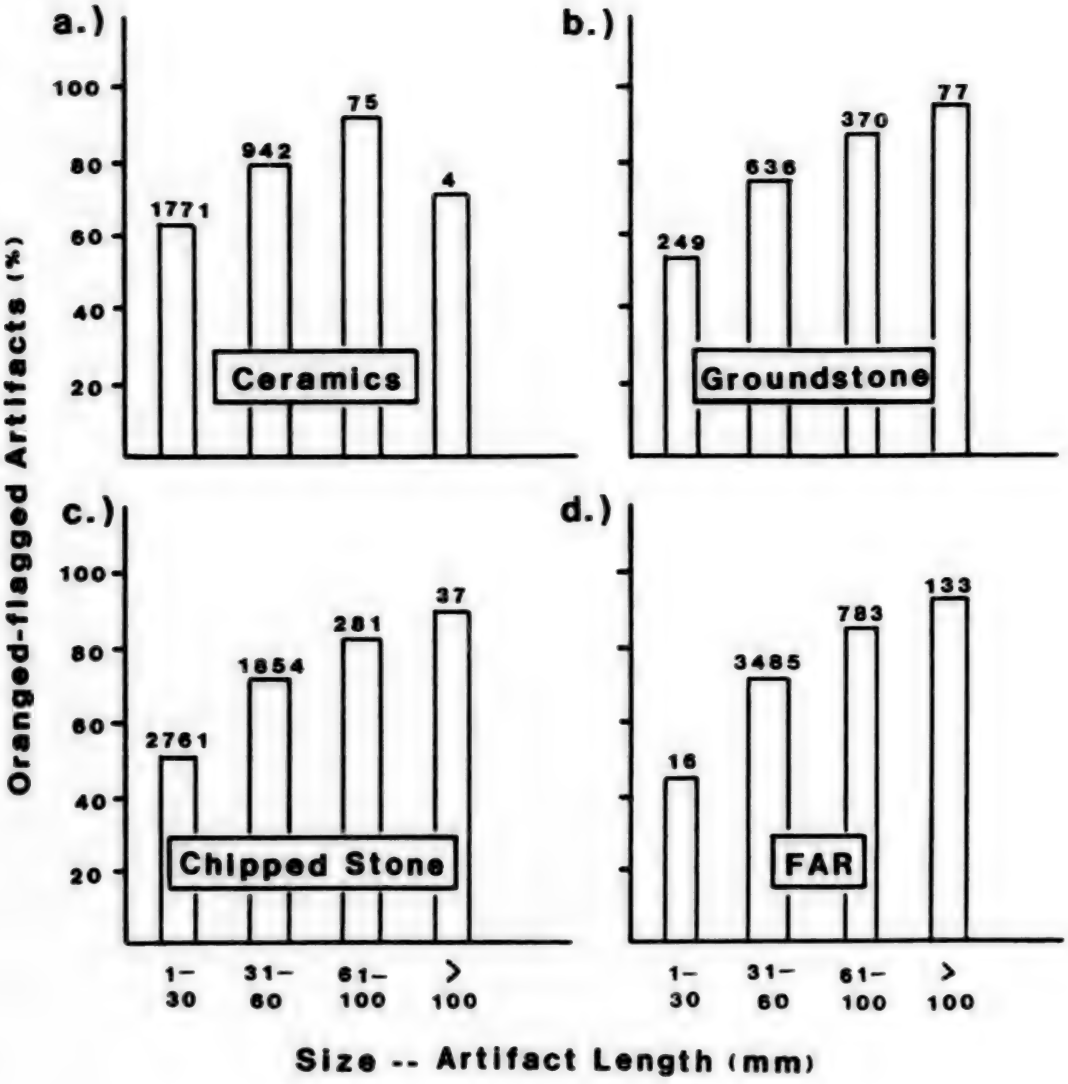


FIGURE 5.2.

PERCENT ARTIFACTS DISCOVERED BY ARTIFACT SIZE CLASS FOR A) CERAMICS, B)CHIPPED STONE, C)GROUNDSTONE , AND D)FIRE-ALTERED ROCK.

BLANK

PAGE

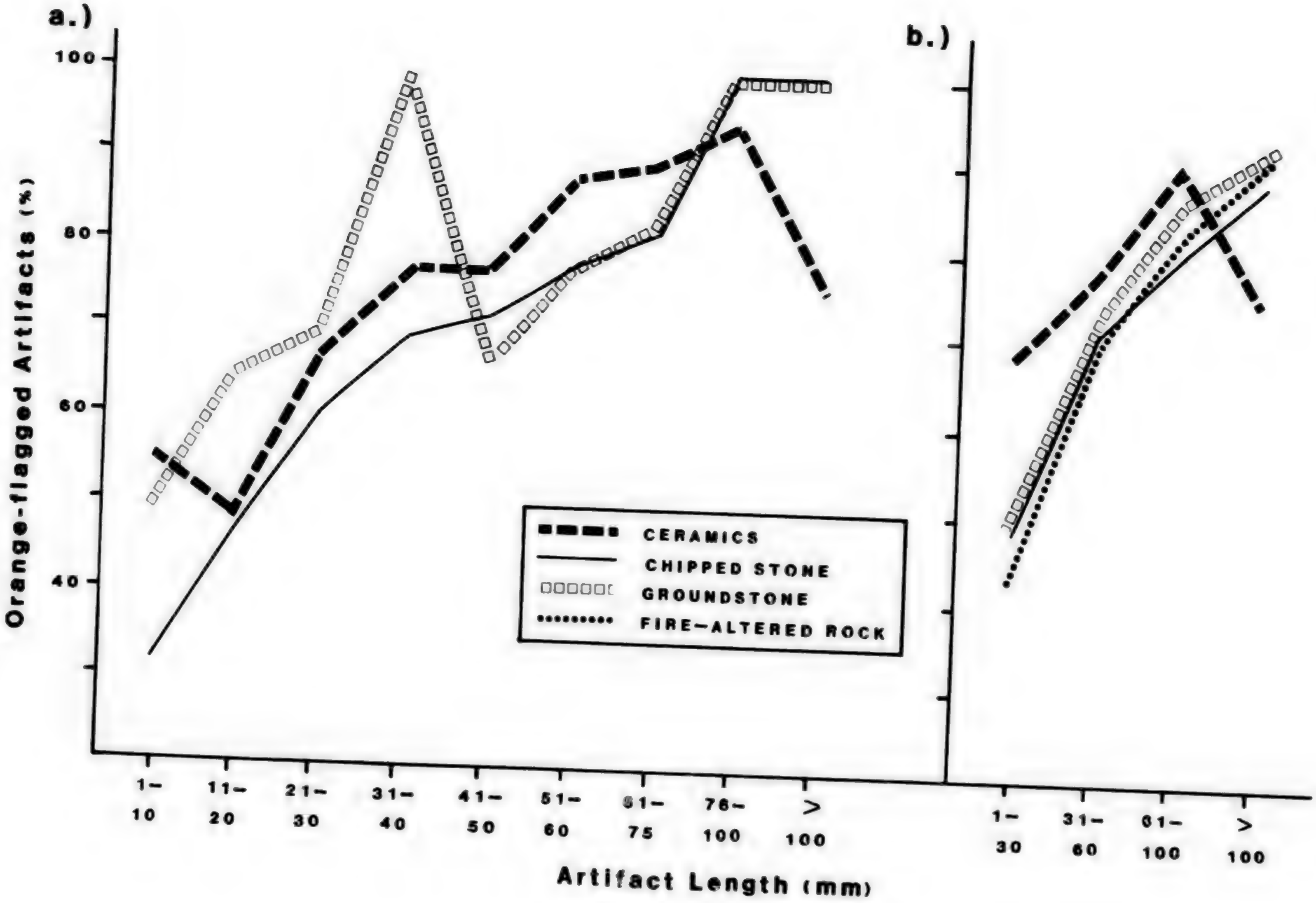


FIGURE 5.3.
PERCENT ARTIFACTS DISCOVERED BY ARTIFACT A) LENGTH
OR B) SIZE CLASS COMPARING ARTIFACT CLASSES.

Table 5.4. Color assignments for lithic material types.

Light	Variable	Dark
Quartzite	Fine-grnd Ryolite	Obsidian
Chalcedony	Undiff Crystall Volc	Oth Glass Volc
Chalc Petr Wood	Chert	Basalt
Indet Sediment	Petrified Wood	Banded Qtz
Sandstone	Indet Cryptocryst	Coarse Ryolite
Qtz Sandstone	Metamorphics	Vesic Basalt
Caliche	Other	Scoria
	Indeterminate	Limestone

which may resemble the gravels found in some portions of most units.

Artifact color was not directly recorded in the field but can be inferred from recorded material type or ceramic type. Table 5.4 gives the inferred colors for each lithic material type. Light colored ceramic wares were too rare within the NHLEP data base to make a similar assessment for ceramics. Those material types given as having a variable color means that some objects with that material type are dark, and others light. Darker artifacts, which might contrast more dramatically with the uniform light brown color of the surface sediments of the study area, were found on the first discovery pass at slightly higher proportions than were variable or lighter color objects (Table 5.5) for chipped stone and groundstone. This difference of 7 percent for both chipped stone and groundstone is almost of the magnitude reported by the Seedskadee discovery accuracy study for which 10 percent more black than buff items were reported discovered.

The above suggests that conspicuous artifacts, by virtue of their size and the deviation in their coloration from the background color of the surface sediments (if they are relatively small), are more susceptible to discovery. Indeed, as Table 5.6 shows for chipped stone (Table 5.6a), if artifact color is held constant, the percentage recovered increases as size does. Similarly, if one holds size constant at 0-30 millimeters or 30-60 millimeters, the percentage recovered increases as material type becomes darker. Darker artifacts were found at consistently higher rates for the 2 smaller size classes between 1 and 60 millimeters in maximum diameter. Larger artifacts, both dark and light, were found at similar rates. The contrast between the first-pass discovery rates of small, light-colored items and large, dark-colored artifacts is considerable. While 100 percent of the later were found, only 50 percent of the former were discovered.

These trends are not seen for groundstone (Table 5.6b) or FAR (Table 5.6c). Indeed, artifact color seems to make very little difference in the discovery of groundstone and FCR. This may be because the shape, texture, and disposition of such artifacts is so aberrant in comparison with other "natural" items found on interdunal surfaces, that these latter characteristics, for which there is no measure in the data base, overwhelm the contribution of color to identifying the object as of cultural origin.

The encoding crew, which returned to survey units to describe the orange-flagged artifacts also discovered and red-flagged other artifacts en route. In all probability, they did not actually find all of the remaining surface artifacts, but artifact discovery during the in-field analysis phase of recording may not have been subject to size and color biases to the same degree as that of the discovery crew. In that the encoding crew

Table 5-5. Percent artifacts flagged in orange (of total given in parentheses) according to artifact class and artifact color.

	COLOR		
ARTIFACT CLASS	Light	Variable	Dark
Chipped Stone	59.1 (1355)	54.8 (1903)	64.9 (1675)
Groundstone	72.4 (970)	78.5 (163)	79.4 (199)
Fire-altered Rock	73.2 (4004)	71.5 (137)	74.7 (273)

did find large numbers of small items, it seems likely that the NHLEP data base contains a representative distribution of size classes, although perhaps not for every square meter surveyed. Without knowledge of what the absolute size distribution from the area should look like, or without a seeding program as described for the Seedskadee Project, however, further evaluation of the accuracy of the record of the surface assemblages with respect to artifact size and color is not possible.

In the Seedskadee artifact seeding test, artifact clusteredness was found to contribute greatly to artifact discovery. This same tendency was sought in the NHLEP data by partitioning the unit sweeps into categories of artifact density based upon the total number of artifacts discovered within each sweep. Thus, if a total of 25 or less items were found in a sweep, the sweep was considered to have low-artifact density. If more than 100 items, flagged in orange or red, were found in a sweep, that sweep was considered high-density. Table 5.7 summarizes artifact discovery rates according to sweep artifact density and artifact attributes of size and color. Whereas in the Seedskadee discovery accuracy test it was found that the percentage of orange-flagged artifacts increased with seeded cluster density, these data show that as artifact density increases, the percentage of orange flagged items decreases (Table 5.7a). As will be discussed in the next section, the relationship between the numbers of orange- and red-flagged items is dependent on the amount of inadvertent resurvey of sweeps by the encoding crew. This in turn is directly dependent on the number of orange-flagged items present in the unit. In general, the fewer orange-flagged artifacts, the less resurvey by the encoding crew, the fewer red-flagged artifacts, and the higher the discovery rate (as measured by percent orange flags of total artifacts).

Table 5.7a shows also that the difference in the discovery rates between small and large items for

Table 5-6. Cross-tabulation of the percentage of artifacts flagged in orange (of the total given in parentheses) according to size class and color for (a) chipped stone, (b) groundstone, and (c) fire-altered rock.

(a) CHIPPED STONE SIZE (mm)		COLOR	
	Light	Variable	Dark
0-30	49.6 (705)	44.4 (1127)	55.9 (929)
30-60	66.9 (535)	68.5 (691)	75.0 (628)
60-100	81.1 (95)	81.0 (79)	80.4 (107)
>100	80.0 (20)	100.0 (6)	100.0 (11)

(b) GROUND-STONE SIZE (mm)		COLOR	
	Light	Variable	Dark
0-30	51.7 (205)	54.5 (22)	45.5 (22)
30-60	72.9 (480)	75.3 (81)	77.3 (75)
60-100	84.6 (228)	90.4 (52)	87.7 (90)
100	93.0 (57)	100.0 (8)	91.7 (12)

(c) FIRE-ALTERED ROCK (mm)		COLOR	
	Light	Variable	Dark
0-30	50.0 (6)	25.0 (4)	50.0 (6)
30-60	70.3 (3170)	71.3 (108)	70.5 (207)
60-100	83.3 (713)	78.3 (23)	91.5 (47)
>100	91.5 (118)	100.0 (2)	92.3 (13)

high density sweeps (>100 artifacts) is almost 40 percent, while the discovery rate difference between small and large items for low density sweeps (those with less than 25 items) is only 25 percent. This pattern is again probably a result of encoding crew resurvey. Artifact analysts return to code orange-flagged artifacts and in the vicinity of those artifacts, find other artifacts which are less obtrusive, those that are smaller.

Interestingly, the pattern in artifact obtrusiveness (as measured by artifact size), artifact density, and artifact discovery rate is reversed when artifact color is considered. As Table 5.7b shows, the difference in orange-flagged items between dark- and light-colored items for high density sweeps is -2 percent (more light- than dark-colored artifacts found), while for low density sweeps this difference is 6 percent. That is, in high artifact density areas, artifact color does not seem to make a difference as to whether or not an artifact is found. In low artifact density areas, however, darker-colored items are more susceptible to discovery.

As a result of the above discussions, the following generalizations are made. In high artifact density areas, increasing artifact size, but not darker coloration, contributes to increased artifact discovery. In low artifact density areas, both artifact size and coloration aid in artifact discovery. Indeed, as Table 5.8 shows for sweeps with 25 or fewer items, about 10 percent more dark- than light-colored artifacts are found, no matter the artifact size. But, 30 percent more large than small artifacts are found, no matter the artifact color.

Environmental Conditions

Since interdunal vegetation is sparse here, analysis of the influence of environmental conditions on artifact discovery is confined to an assessment of the effect of temperature, different light qualities, and wind velocity at the time of survey on artifact discovery. Fieldwork began in earnest in January of 1985, (although it had commenced in early December of 1984) and ended in April of 1985. During this time, quality of light increased during the early morning field day hours as the sun rose earlier and earlier, and afternoon windiness and minimum and maximum temperatures increased (Department of Commerce 1985). Of course, air temperature generally also increased throughout the day. It is our feeling that discovery conditions for the majority of the field season were close to ideal, especially with respect to temperature, although there were several days upon which survey was conducted under horrendous conditions.

In terms of artifact recovery, each of these environmental factors can be modeled to have a slightly different effect. The effect that temperature could have on artifact discovery is dependent in part on the influence that temperature has on how quickly an area is surveyed, and in turn, how much the amount of time spent surveying an area influences artifact discovery. It is our impression that the longer that one looks in a particular area, the more one finds. Parenthetically, this impression is supported by Figure 5.4 which shows the area in which all of the points that map artifact discovery percentages versus elapsed transect time fall for six different transect artifact totals. In general, the more time spent surveying a particular transect, given relative artifact density, the more artifacts discovered. Note that there is no simple linear relationship between elapsed survey time and percentage of artifacts discovered. For example, for low artifact density transects, if 17 minutes was spent surveying that transect, than all artifacts were discovered by the first pass. If however, 4 minutes were spent surveying a low density transect than between 50 percent and 100 percent of all items located in that transect were found on the first pass. A similar trend is more clearly seen for moderate and higher transect artifact densities in that while spending a great deal of time surveying the transect appears to ensure high artifact discovery rates, spending a relatively lesser amount of time in transect survey does not necessarily ensure low artifact discovery rates.

Returning to other effects that temperature may have on artifact discovery, then, it is possible that if cold temperatures inspire brisk surveying and hence low transect survey times, than lower discovery crew artifact discovery rates may ensue. Conversely, if higher temperatures lead to leisurely survey speeds, then longer transect survey times and higher artifact discovery rates may result. It may also be the case that with

100

Table 5.7. Percentage of artifacts flagged in orange (of total given in parentheses) according to relative sweep artifact density, i.e., total number of artifacts recorded within a sweep, and (a) artifact size class and (b) artifact color.

(a) ARTIFACT SIZE (mm)	SWEEP ARTIFACT DENSITY 0-25	25-100	>100
0-30	68.3 (186)	52.5 (1041)	52.1 (3323)
30-60	80.6 (500)	73.6 (2091)	69.4 (4231)
60-100	84.6 (130)	86.5 (488)	82.5 (848)
100	92.9 (28)	91.5 (82)	91.5 (130)

(b) ARTIFACT COLOR	SWEEP ARTIFACT DENSITY 0-25	25-100	>100
Light	76.2 (407)	72.8 (1955)	67.6 (3807)
Variable	79.2 (104)	63.9 (599)	52.2 (1391)
Dark	82.5 (303)	67.6 (1148)	65.6 (3334)

Table 5.8. Cross-tabulation of artifact discovery rate (percent orange flagged items of total given in parentheses) according to artifact size and coloration for low artifact density sweeps, i.e., those with an artifact total of 25 or less.

	COLOR		
ARTIFACT SIZE (mm)	Light	Variable	Dark
0-30	63.4 (41)	65.9 (41)	71.2 (104)
30-60	76.4 (276)	79.4 (68)	88.5 (156)
60-100	78.9 (71)	100.0 (21)	86.8 (38)
>100	89.5 (19)	100.0 (4)	100.0 (5)

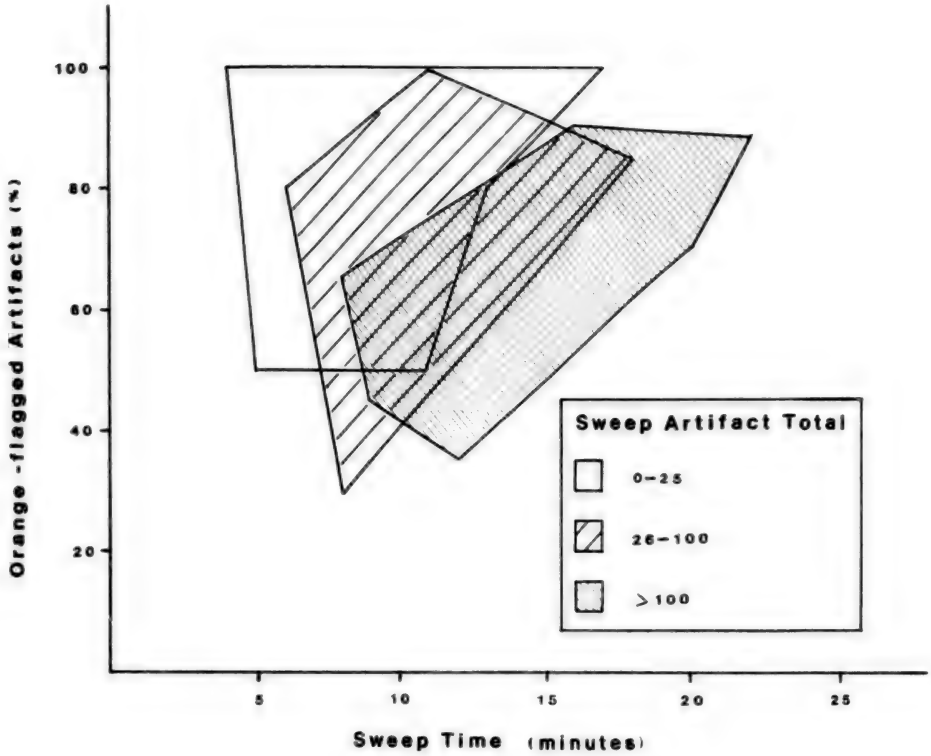


FIGURE 5.4.

LIMIT OF AREA WITHIN WHICH MOST POINTS RELATING THE PERCENT ARTIFACTS DISCOVERED TO AMOUNT OF ELAPSED SWEEP TIME BY SWEEP ARTIFACT TOTAL.

higher temperatures, fatigue and inattention to procedures might increase making for lower recovery rates.

Poor quality light, defined as low-angled (as is true of early morning and late afternoon light) or as low-intensity light common on overcast days, should diminish artifact discovery rates compared to discovery done under conditions of higher quality light. Relatively lower artifact discovery rates would be expected on cloudy days and at those times of the day, early morning and late afternoon, when the location of the sun on the horizon is low.

Finally, with the high winds of springtime, visibility may be impaired, with obvious consequences for artifact discovery. With continued windiness, however, artifact exposure may increase (Wandsnider 1986a, 1986b) leading to apparently higher artifact discovery rates.

It is unclear what the composite effect of all of these lesser effects might be. In the following analyses, several different discovery rates are derived for unit sweeps given in Table 5.3 according to the windiness and light quality, as recorded for sweeps by the crew chief in the field, and to inferred temperature at time of survey. Artifact discovery rates for sweeps are estimated using the spatial coordinates of artifacts contained in the NHLEP data base. Thus, the data to explore the questions addressed in this section and the next are based on our ability to merge information on the discovery form with the artifact location and description data base. On the discovery form, the beginning and ending time of each sweep was recorded as was the number of artifacts tallied by the crew member in each sweep position for each sweep. In the artifact data base, both flag color and spatial coordinate for each artifact are represented. Because the survey was spatially well controlled, theoretically, at some spatial level, the artifact x coordinate can be associated with survey transect and indeed, an algorithm was written to convert the x coordinate to the sweep and sweep position number. Thus, one should be able to translate between the two data files and talk about which sweep an artifact was discovered in and what crew member found which artifacts at what time.

Several qualifying words have been used above because it has not been proven that such a correspondence between the discovery form and the artifact data base is possible at least at the scale of the 5 meter transect. This lack of confidence is inspired by the less than perfect agreement between the discovery form artifact tallies and orange flag tallies made for the simulated transects in the artifact data base. The two different tallies are within the same order of magnitude, but often the discovery tally is as much as 50 percent higher than the simulated tally and is sometimes lower. Thus, the correlation between the orange flag tallies from the discovery form and from the simulated transects for each individual is significant (alpha=.0001), but not espcailly high (Pearson's product-moment correlation coefficient=0.78).

Several reasons for this discrepancy exist. Among them is the effect of forcing an undulating piece of terrain into the two dimensions of x and y, such that artifacts located by the discovery crew on a slope at some distance from each other will appear to be in close proximity when just the x,y coordinates are considered. For this to be a major effect, however, the terrain surveyed would have be mountainous, which is clearly not the case in the NHLEP area. Probably the most important reason for the discrepancy is that, although the survey was well controlled to ensure even coverage, the difficulty of maintaining a transect as straight as the simulated transect, given the incidence of coppice dunes, is high enough to preclude the exact correspondence between individual actual and simulated transect tallies. One final factor contributing to this discrepancy comes from the fact that the artifact analysis crew, upon returning to the flagged item, would decide the item was not actually an artifact and thus it was not included in the artifact data base. This sort of decision was often made for caliche which has been flagged because it resembled FCR.

At the scale of the 25 meter sweep, all but the last of these effects on the disagreement between observed and simulated sweep totals should be minimized. Indeed, it was found that discovery form sweep totals and simulated sweep orange flag counts closely agree and were positively correlated with a Pearson's product-moment correlation coefficient of 0.944 (which is significant at the 0.0001 level). Thus, analysis of sweep totals which relies on the correspondence between weather and time notes on the discovery form and simulated sweep provenience as derived from the artifact data base can be undertaken with confidence.

Table 5.9 presents Chi-square values summarizing the distribution of the completed sweeps with respect to two kinds of variables: an environmental variable (temperature, light quality, time of day, and wind intensity) and sweep artifact total (in three classes of low, 0-25, medium, 25-100, and high, greater than 100). The actual distributions of the completed discovery sweeps with respect to these variables are given in 5.10b, 5.11b, 5.12b, and 5.13b. As shown in Table 5.9, there are significant (at least at the 0.01 level), nonrandom distributions of completed sweeps with respect to sweep artifact total and environmental variables of temperature, wind intensity, and time of day.

Three different measures could be used to evaluate artifact discovery accuracy with respect to environmental conditions. The simplest of these, and one that was used with success in the previous section, is the percentage of orange-flagged artifacts of all discovered artifacts. As already discussed, however, the orange-red flag relationship is not stable, but

Table 5.9. Chi-Square values evaluating the cross-tabulation of completed sweeps (refer to number of sweeps in the following tables) by environmental value and sweep density.

ENVIRONMENTAL VARIABLE	CHI-SQUARE	CRITICAL VALUE	SIGNIFICANCE LEVEL
Temperature * +	22.31	21.96	0.005
Light Quality	9.44	10.64	0.100
Time of Day *	44.80	32.91	0.001
Wind Intensity *	17.81	16.81	0.010

NOTES: + temperature values collapsed from 5 degree to 10 degree levels to reduce the number of low frequency cells.

* significant difference in the distribution of completed sweeps with respect to sweep density and environmental values.

seems to vary according to artifact density. Because less resurvey is done in low artifact density sweeps by the encoding crew, fewer artifacts are red-flagged and the percent of orange-flagged artifacts is much higher than compared to high artifact density sweeps. Indeed, as Figure 5.5 shows, the relationship between orange and red flagged items is approximately the same for low and moderate artifact density sweeps (there are approximately 0.23 or 0.24 red flagged items for every one orange-flagged artifact), but is different for high density sweeps (for every one orange-flagged artiface, 0.39 artifacts are red-flagged). Percent orange-flagged artifacts, thus, is a poor measure of artifact discovery when the unit of analysis is, as in this case, a unit of space like the sweep, which may have very different artifact densities. A measure which circumvents this inadequacy considers the sweep mean number of orange-flagged items by sweep. In Table 5.10, for example, the mean number of orange-flagged artifacts found in sweeps completed when the temperature was between 35°F and 40°F was 11. This measure of artifact discovery rate is insensitive to encoding crew discovery (no red-flagged artifacts contribute to the measure), but may be influenced by variability in sweep artifact totals, a characteristic of the archaeological record. We find for this measure then, that the standard deviation is approximately equal to the mean. The final measure which attempts to circumvent this last problem is the mean of the sweep percent of orange flags found in each unit. It is calculated by determining the proportion of orange flags found in a sweep of the unit total of orange-flagged artifacts and, if the distribution of artifacts throughout a unit is continuous and not subject to discovery bias, should be about 6.25 percent (100 percent divided by 16 sweeps). This proportion is averaged over all sweeps having the same environmental variable value. This measure, too, also has a standard deviation approximately the same as the mean and so does not appear to provide more or better information about artifact discovery rates as was hoped. In the following tables, all three measures are presented but only the mean sweep total of orange-flag artifacts is discussed in any depth, since this measure seems to make the most intuitive sense.

In the following tables, part (a) considers all

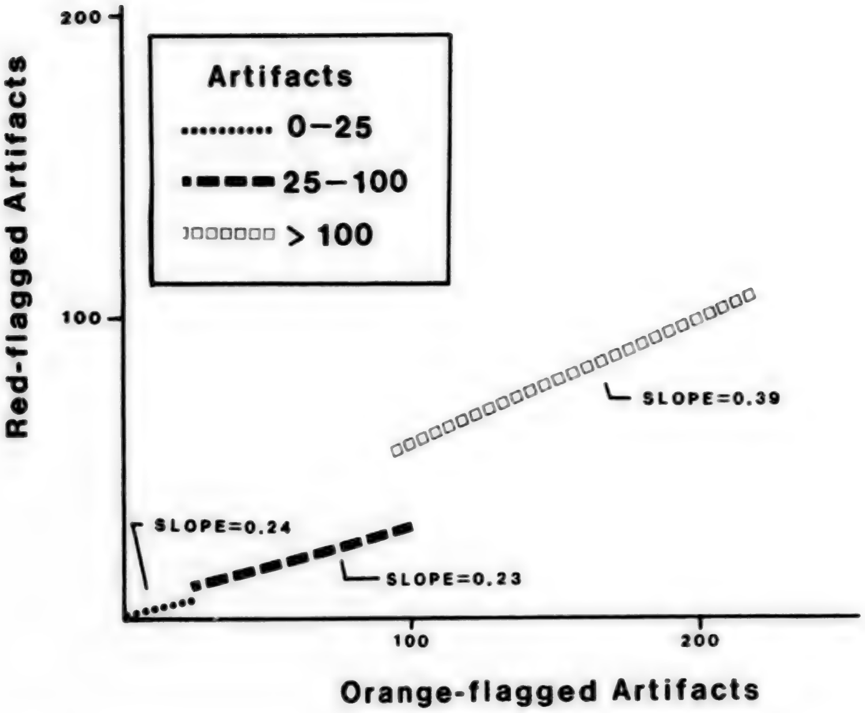


FIGURE 5.5.

RELATIONSHIP BETWEEN THE NUMBER OF RED- AND ORANGE-FLAGGED ARTIFACTS ACCORDING TO SWEEP ARTIFACT TOTAL.

sweeps in Table 5-3 regardless of sweep artifact total. In general, the means and standard deviations of sweep orange-flagged artifact total and sweep orange-flagged percentage given in portion (a) of the following four tables are approximately equal. In an effort to reduce the standard deviations, which results from variability in the density and distribution of the surface archaeology, sweeps were stratified according to the total number of artifacts discovered therein, and discovery rates are again analyzed within these density strata given in part (b) of the following tables. It is the number of sweeps given in part (b) of these tables that was used to calculate Chi-square values given in Table 5.9. This stratification, however, did little to reduce the apparent amount of variability in discovery rate measures.

The low-power Chi-square analysis of the distribution of sweeps with respect to temperature (in 10 degree, rather than 5 degree intervals) and artifact density indicates that there are fewer than expected low-density sweeps completed when the temperature is high (80°F-90°F), that there are fewer than expected high-density sweeps completed when it is cool (50°F-60°F), and that there are more than expected high-density sweeps completed when it is warm (70°F-80°F). Table 5.10 considers artifact discovery with respect to inferred temperature at the time the sweep was completed. Inferred temperature was calculated as discussed in Table 5.10 using minimum and maximum temperatures published for the El Paso airport (Department of Commerce 1985). As seen in 5.10a, both the mean number of orange-flagged items and the mean sweep percentage of orange flags increases as temperature increases. The standard deviations for both of these measures are quite high, and neither of these trends are found to be statistically significant. When temperature is collapsed into 10 degree intervals, however, a Kruskal-Wallis test of ranked mean sweep totals of orange-flagged artifacts finds these differences significant at the 0.10 level. But, when sweeps are separated according to artifact total, little patterning is found in artifact discovery with respect to temperature. Thus, only weak support is found for warmer temperatures, perhaps inspiring leisurely survey speeds, correlating with higher discovery rates. It is suspected that more survey performed under extreme conditions, either warmer or colder, may clarify this trend.

The effect of light quality on discovery accuracy was analyzed in two ways. First, artifact discovery rates were considered with respect to in-field notes on light conditions which ranged from sunny, to partially overcast, to overcast, to overcast and raining. The Chi-square evaluation of the distribution of completed sweeps with respect to light conditions and sweep artifact total shows no nonrandom relationship (Table 5.9). That is, there is no significant tendency for low-density sweeps to be completed under either sunny or rainy conditions. Table 5.11a, however, shows that much higher orange-flagged artifact total and sweep percentage means are true of sweeps completed on sunny days (42.4 mean sweep total and 6.9 mean sweep percent) than on rainy days (8.3 and 4.6, respectively). Again, the standard deviations for each of these measures are quite high and these trends, which are the direction expected, are not statistically significant. When sweeps are stratified according to artifact density as in Table 5.11b, no single pattern emerges.

The effect of light quality on artifact discovery may also have a diurnal component in which artifact discovery is hampered by shadows attendant to early morning and late afternoon light. The Chi-square evaluation of the distribution of completed sweeps with respect to time of day and sweep artifact total finds significant nonrandomness in this distribution (Table 5.9). In general, more low-density sweeps than expected are completed in the early morning (7 am-10 am) and late afternoon (2 pm-3 pm) hours. Conversely, more high-density sweeps than expected are completed during the middle portion of the day (10 am-1 pm). Table 5.12 supports this tendency. The mean number of orange-flagged artifacts and the mean percentage of orange-flags begin low in the morning, are highest in the middle part of the day, and fall off during the afternoon. The standard deviations of these measures are again very high, but a Kruskal-Wallis test comparing the sum of the ranks of the mean orange-flag sweep totals finds there to be a significant difference (at the 0.0001 level). Similar trends are present in Table 5.12b showing that no matter the artifact density, artifact discovery is lowest in the early morning and late afternoon and highest about midday. Obviously, in addition to light quality, there are other conditions, e.g., crew member alertness, with similar temporal cycling, which might influence artifact discovery. This contributing factor is discussed in the next section.

The final environmental factor that might play an important role in artifact discovery to be considered here is that of wind intensity. As seen in Table 5.9, there is a significant nonrandom distribution of completed sweeps with respect to sweep artifact density and wind intensity. There are fewer than expected low-density sweeps completed when it is calm and more than expected low-density sweeps completed when it is very windy. And conversely, more than expected high-density sweeps are completed when it is calm and fewer than expected high-density sweeps are completed when it is extremely windy. Table 5.13a reinforces this pattern; in general, both the mean sweep total of orange-flagged artifacts and the mean sweep percentage of orange-flagged artifacts decrease as wind intensity increases. A Kruskal-Wallis test of ranks of mean orange-flagged artifact totals (by sweep) shows this trend to be significant at a level of 0.11. That is, the probability that the distribution of artifact ranks with respect to windiness is due to chance is 0.11. When sweeps

Table 5-10. Artifact discovery rates according to inferred temperature at the time the sweep was completed for (a) all sweeps and (b) sweeps stratified according to total number of artifacts.

(a)

TEMPERATURE* degrees)	No. of Sweeps	No. of Flags Orange	Red	Orange Flags %	Mean	Std	Sweep % Orange Flags Mean	Std
35	2	22	1	95.7	11.0	5.7	1.0	0.5
40	15	216	110	66.3	14.4	14.9	1.8	1.2
45	27	1224	644	65.5	45.3	57.3	7.4	8.0
50	49	1523	709	68.2	31.1	53.7	7.0	7.8
55	38	1365	594	69.7	35.9	32.9	6.0	6.3
60	41	1333	664	66.8	32.5	41.3	5.6	4.4
65	25	1118	604	64.9	44.7	48.1	11.0	20.9
70	12	799	419	65.6	66.6	115.1	7.6	7.3
75	8	598	354	62.8	74.8	37.6	8.4	4.2
80	4	429	187	69.6	107.3	94.0	7.7	6.8
85	2	69	57	54.8	34.5	7.8	2.5	0.6

SWEEP DENSITY

(b)

TEMPERATURE*	< 25 ARTIFACTS				25 - 100 ARTIFACTS				>100 ARTIFACTS			
(degrees)	No. of Sweeps	Orange Flags %	Mean	Std	No. of Sweeps	Orange Flags %	Mean	Std	No. of Sweeps	Orange Flags %	Mean	Std
35	2	95.7	11.0	5.7								
40	10	81.4	5.7	4.4	5	62.1	31.8	12.8				
45	12	72.5	4.2	5..9	5	73.5	28.8	13.2	10	64.3	103.0	57.0
50	27	75.6	5.4	5.6	17	71.0	35.9	14.0	5	65.0	153.2	101.8
55	14	73.6	6.4	4.5	19	74.5	41.4	16.1	5	62.6	98.0	27.5
60	21	83.8	6.1	5.8	12	70.5	30.8	11.4	8	63.3	104.3	38.2
65	13	82.9	6.7	7.4	4	78.8	49.3	28.6	8	61.0	104.3	27.4
70	7	90.0	3.9	7.2	1	90.0	27.0		4	64.3	186.3	140.2
75					3	53.9	34.3	20.6	5	65.0	99.0	17.2
80					2	61.5	42.5	16.7	2	71.9	173.0	94.8
85					2	54.8	34.5	7.8				

NOTE: *Temperature at the time of the sweep was completed was calculated using a sin function which scaled the sweep temperature between the recorded minimum temperature (assumed to have occurred at AM) and the recorded maximum temperaturfe (assumed to have occured at PM) so that most of the increase in temperature occurred from around AM to PM. The formula used is:

TEMP = MIN + HALFDIFF + (HALFDIFF * SIN((TIME/360*0.005235987) -1.570796327))

MIN = recorded minimum temperature
HALFDIFF = half of the difference between recorded minimum and maximum temperatures
TIME = time at the completion of a sweep in minutes from midnight

The divisor of 360 translates the time so that the warming trend begins at AM (360) minutes past midnight). The value of 0.005235987 transforms the time value to radians. The value of 1.570796327 translates the radian value to between negative and positive one-half pi, for which the sin function maps a signoidal curve on the y axis (in this case, temperature).

ƒ Kruskal-Wallis test of ranks of mean sweep total of orange-flagged artifacts according to temperature in 10, not 5, degree intervals) results in Chi-square approximation of 7.88 (degrees of freedome=4; the probability of a larger Chi-square approximation value if 0.0961).

BLANK
PAGE

Table 5.11. Artifact discovery rates according to the light quality recorded by the discovery crew chief in the field at the completion of every 4 sweeps for (a) all sweeps and (b) sweeps stratified by artifact total.

(a)

LIGHT QUALITY	No. of Sweeps	No. of Flags Orange	No. of Flags Red	Orange Flags %	Orange Flags Mean *	Orange Flags Std	Sweep % Orange Flags Mean	Sweep % Orange Flags Std
Sunny	151	6401	3332	65.8	42.4	59.6	6.9	10.2
Partly Cloudy	40	1203	526	69.6	30.1	37.4	6.8	7.9
Overcast	43	1158	545	68.0	26.9	31.9	6.2	7.2
Raining	4	33	10	76.7	8.3	7.4	4.5	4.1

SWEEP DENSITY

(b)

LIGHT QUALITY	<25 ARTIFACTS No. of Sweeps	<25 ARTIFACTS Orange Flags %	<25 ARTIFACTS Orange Flags Mean	<25 ARTIFACTS Orange Flags Std	25 - 100 ARTIFACTS No. of Sweeps	25 - 100 ARTIFACTS Orange Flags %	25 - 100 ARTIFACTS Orange Flags Mean	25 - 100 ARTIFACTS Orange Flags Std	>100 ARTIFACTS No. of Sweeps	>100 ARTIFACTS Orange Flags %	>100 ARTIFACTS Orange Flags Mean	>100 ARTIFACTS Orange Flags Std
Sunny	70	79.9	6.0	5.8	46	68.8	34.7	15.7	35	63.7	125.2	73.5
Partly Cloudy	22	83.5	4.4	5.5	10	69.9	35.6	16.1	8	68.0	93.9	24.5
Overcast	22	73.7	4.5	4.6	17	71.9	38.5	15.5	4	61.4	101.5	30.1
Raining	4	76.7	8.3	7.4								

NOTE: *Kruskal-Wallis test of ranks of mean sweep total of orange-flagged artifacts according to light quality results in Chi-square approximation of 4.69 (degrees of freedome=3; the probability of a larger Chi-square approximation value is 0.1960).

Table 5.12. Artifact discovery rates according to the hour by which the sweep had been completed as recorded by the discovery crew chief in the field for (a) all sweeps and (b) sweeps stratified by artifact total.

(a)

HOUR TRANSECT COMPLETED BY	No. of Sweeps	No. of Flags Orange	No. of Flags Red	Orange Flags %	Orange Flags Mean *	Orange Flags Std	Sweep % Orange Flags Mean	Sweep % Orange Flags Std
9:00 AM	6	58	17	77.3	9.7	17.4	2.4	2.4
10:00 AM	56	718	276	72.2	12.8	17.2	3.4	4.9
11:00 AM	50	2134	1121	65.6	42.7	48.0	10.1	15.7
12:00 PM	34	1876	826	69.4	55.2	72.4	7.5	7.1
1:00 PM	28	1893	1113	63.0	67.6	76.2	8.9	6.0
2:00 PM	38	1688	801	67.9	44.4	48.4	7.7	8.1
3:00 PM	26	428	259	62.3	16.5	17.8	3.7	3.2

SWEEP DENSITY

(b)

HOUR TRANSECT COMPLETED BY	< 25 ARTIFACTS No. of Sweeps	< 25 ARTIFACTS Orange Flags %	< 25 ARTIFACTS Orange Flags Mean	< 25 ARTIFACTS Orange Flags Std	25 - 100 ARTIFACTS No. of Sweeps	25 - 100 ARTIFACTS Orange Flags %	25 - 100 ARTIFACTS Orange Flags Mean	25 - 100 ARTIFACTS Orange Flags Std	> 100 ARTIFACTS No. of Sweeps	> 100 ARTIFACTS Orange Flags %	> 100 ARTIFACTS Orange Flags Mean	> 100 ARTIFACTS Orange Flags Std
9:00 AM	5	72.2	2.6	1.8	1	78.9	45.0	.				
10:00 AM	39	80.0	4.0	4.7	16	71.8	29.9	13.7	1	62.9	83.0	.
11:00 AM	20	75.8	5.7	6.1	16	67.4	37.6	17.2	14	64.1	101.4	49.5
12:00 PM	15	80.5	2.2	2.9	8	70.7	45.6	17.8	11	68.9	134.4	76.6
1:00 PM	6	79.5	5.2	6.4	10	67.6	34.2	14.7	12	61.8	126.7	84.2
2:00 PM	14	79.7	10.9	4.2	16	73.6	35.4	15.8	8	63.4	121.1	51.4
3:00 PM	19	81.0	7.8	6.6	6	62.7	34.7	12.6	1	41.5	71.0	.

NOTE: *Kruskal-Wallis test of ranks of mean sweep total of orange-flagged artifacts according to time of day results in Chi-square approximation of 40.64 (degrees of freedom=6; the probability of a larger Chi-square approximation value is 0.0001).

Table 5-13. Artifact discovery rates according to the wind intensity recorded by the discovery crew chief in the field at the completion of every 4 sweeps for a) all sweeps and b) sweeps stratified by artifact total.

(a)

WIND INTENSITY (knots)	No. of Sweeps	No. of Flags Orange	Red	Orange Flags %	Mean #	Std	Sweep % Orange Flags Mean	Std
0-15	139	6119	3271	65.2	44.0	58.8	6.8	10.1
0-15, gusts*	55	1568	844	65.0	28.5	33.7	6.4	6.7
15-25	20	712	184	79.5	35.6	63.1	7.7	11.4
>25	24	396	114	77.6	16.5	19.0	6.4	7.6

SWEEP DENSITY

(b)

WIND	<25 ARTIFACTS				25 - 100 ARTIFACTS				>100 ARTIFACTS			
INTENSITY (knots)	No. of Sweeps	Orange Flags %	Mean	Std	No. of Sweeps	Orange Flags %	Mean	Std	No. of Sweeps	Oange Flags %	Mean	Std
0-15	60	82.3	5.1	5.7	45	69.5	37.8	17.2	34	62.6	121.0	71.5
0-15, gusts*	26	74.5	4.7	5.3	21	67.7	31.3	10.9	8	61.7	98.5	24.8
15-25	14	73.7	5.2	5.7	2	66.4	38.5	19.1	4	82.5	140.5	77.4
25	18	80.1	8.1	5.6	5	82.9	34.8	16.8	1	84.7	77.0	.

NOTES: *with gusts to 20-25 knots

# Kruskal-Wallis test of ranks of mean sweep total of orange-flagged artifacts according to light quality results in Chi-square approximation of 6.12 (degrees of freedom=3; the probability of a larger Chi-square approximation value is 0.1060).

are stratified by artifact density (Table 5-13b), the general tendencies persist but are less vivid. Therefore, it is concluded that wind intensity contributes negatively to artifact discovery accuracy, but this is not a very robust pattern.

In the above, several factors have been identified which seem to have definite effects on artifact discovery. The most robust pattern to emerge is that between artifact discovery and time of day, with relatively more artifacts being found in the middle of the day, and fewer in the early morning or late afternoon. The presence of low-angle light at these latter times of the day and other factors, such as waning and waxing crew member attentiveness, may be responsible for this trend. Wind intensity also negatively contributes to artifact discovery, although to a lesser degree than whatever the variable "time of day" is measuring. There also exists a small tendency for more artifacts to be found with increasing temperature and under sunny rather than rainy conditions.

These tendencies indicate that the accuracy of the archaeological record is directly affected by previously suspected, but undocumented, environmental factors. All units will be affected by the "time of day" effect, since only units with very sparse artifact densities were surveyed in a few hours. Thus, the accuracy of each unit will be uneven, due to this effect alone. It is suspected that the artifact color size bias discussed in the last section may be more marked for early morning and late afternoon hours although no analysis has been conducted to verify this. It is also interesting to speculate about the influence of this effect on artifact attribute coding. Future applications of this technique will note the hour of encoding and analysis of diurnal coder variability will ensue. If it could be found, for example, that encoding quality did not suffer during early morning or late afternoon hours, than perhaps coding could be relegated to these hours of the day and discovery confined to midday, at which time it seems to be optimal.

On the NHLEP, survey was rarely conducted under poor conditions of high wind or rain. In addition to minimizing crew member discomfort, it was suspected that such conditions may negatively impact the quality of the archaeological record. As these analyses have shown, such a fear was well founded.

Surveyor Characteristics

Surveyor interest, experience, and physical capabilities will also directly affect the quality of the archaeological record. A survey crew of neophytes would probably return from the field with a very different archaeological record than that brought back by an experienced crew. The data has been examined for trends in individual fieldworker discovery rates which might be related to capability, fatigue, and boredom.

Table 5.14 presents one measure of artifact discovery performance for all discovery crew members. It was determined from the discovery form completed by the discovery crew chief in the field by first calculating the sweep artifact total and then figuring the proportion of the sweep total found by individual crew members. In the long run, everyone should have their chance to encounter and flag both low and high density transects. Thus, it was expected that through the course of the discovery season, everyone should have flagged about 20 percent of the artifacts discovered.

As Table 5.14 shows, however, this is not the case with individual sweep proportions ranging from 6 percent to 25 percent. Some of the extreme values, like that of Discoverer 10 (6 percent) and Discoverer 8 (25 percent) may be due to an inadequate sample size of completed transects. Some of the low values can be explained by lack of experience and lack of interest. In the case of Discoverer 5, the somewhat low sweep proportion may be due to the fact that in addition to spotting, flagging, and tallying artifacts, Discoverer 5 was also responsible for, as discovery crew chief, sighting on the transect guide and keeping order in the ranks. For crew members with little or no experience, but high interest, moderate values of the mean sweep proportion are recorded. Some of the higher than expected values may be explained by the advent of crew members flagging items which the artifact coding crew later decided were not artifacts. Also, several of the crew members with high values of mean sweep proportion were particularly notorious for their complacent walking gaits and, as already discussed, since

Table 5.14. Mean sweep tally percentage by survey crew member as calculated from discovery forms.

Crew Member	Completed Transects	Percent Individual of Discovered of Sweep total	
		Mean	Std
Ascher	40	6	10
Stein	16	9	16
Simons	424	16	17
Pike	96	17	20
Steel	408	17	19
Camilli	192	19	19
Hayden	64	19	17
Roney	192	19	16
Mann	112	20	18
Niles	152	21	19
Wase	96	21	12
Hobbs	120	22	19
Kayser	224	22	20
Larralde	64	25	30

the amount of time spent looking for artifacts usually yields more artifacts found, the higher mean sweep proportions are not unexpected. Some of these possibilities are further addressed below.

This discussion will begin by considering Figure 5.6 which returns to the question of the differential discovery of artifacts due to their obtrusiveness. Figure 5.6a, with its intimidating mass of data points, gives artifact discovery rates for each individual, who surveyed transects in at least 4 of the units considered for analysis here, with respect to chipped stone size and color. Essentially, this graph shows the scatter of points around the chipped stone discovery rates mapped in Figures 5.1b and 5.2. For example, of all of the artifacts between 0 and 10 millimeters in length that were found in transects surveyed by Discoverer 1, Discoverer 1 pinflagged in orange about one-third of these; in transects surveyed by Discoverer 2, Discoverer 2 pinflagged 100 percent of all artifacts between 0 and 10 millimeters in length.

Several aspects of this graph are of interest. First, the amount of variability in the individual discovery percentages is not constant for all chipped stone length classes. For example, the range in individual discovery percentages is highest for the 0-10 millimeter length class (from 25 percent to 100 percent) and lowest for the larger length classes. If this variation were due to the variability in artifact frequencies within each of those length classes (refer to Figure 5.1b for frequencies), a large range in individual discovery percentages for those length classes with low numbers of items as in the 0-10 millimeter, 60-75 millimeter, 75-100 millimeter, and 100 millimeter classes might be expected. As Figure 5.6a shows, however, of these length classes only the smallest, 0-10 millimeter, shows a high amount of variability. The variability in individual discovery percentages suspected is almost solely related to artifact obtrusiveness and proximity of the surveyor to that artifact so that all large artifacts, light- and dark-colored, between 2.5 and 0.5 meters from the surveyor are as likely to be found as as small, dark-colored artifacts at 0.5 meters. The further the latter is from the surveyor, the lower the probability of its discovery.

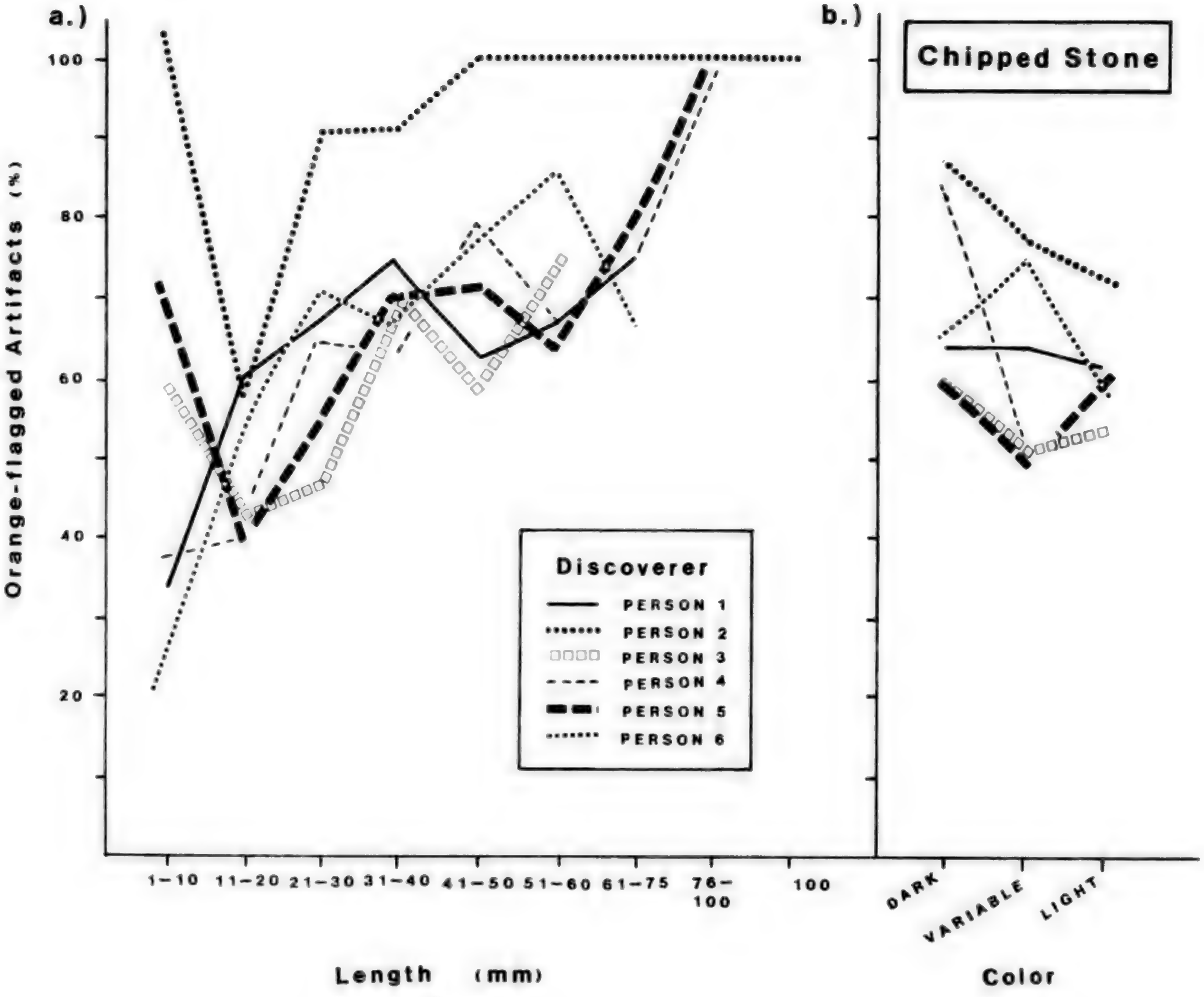
Second, with respect to every chipped stone size class, most individuals do not maintain the same position within the pack of observations. That is, no one crew member remains at the bottom of the spread of points as each size class is examined. One individual, Discoverer 2, is an exception to this; he has consistently orange-flagged more than anyone else, no matter its size or color.

Figure 5.6b examines individual discovery percentages with respect to chipped stone color. In general, most discovery crew members show approximately the same discovery rates with around 60 percent of the dark-colored items, 52 percent of the variably-colored items, and between 52 percent and 60 percent of the light-colored items being discovered. Interestingly, Discoverer 2 is again the exception and seems more sensitive to artifact color in that Discoverer 2 flagged more than 85 percent of dark chipped stone, but only about 75 percent of the lighter chipped stone. Only one other crew member, Discoverer 4, registered as large a difference attributable to color with 83 percent of the dark-colored artifacts and 60 percent of the light-colored artifacts discovered.

The graphs for the other artifact classes of

FIGURE 5-6.

PERCENT OF CHIPPED STONE DISCOVERED VS CHIPPED STONE LENGTH AND COLOR FOR INDIVIDUAL DISCOVERY CREW MEMBERS.



ceramics, groundstone, and FAR (not presented here) are very similar both in the spread of points for each size class, and, except for Discoverer 2 (who consistently flagged more items no matter the type), there is little trend in individual discovery rates between size or color classes.

Discovery crew membership was not constant through the season, and members of the discovery crew performed other tasks besides just surveying. Despite these precautions taken to minimize the amount of boredom or fatigue inherent to redundant tasks, is there any trend in seasonal performance in artifact discovery which might be related to fatigue or boredom? Table 5.15 presents figures for individual artifact discovery rates throughout the season. Figure 5.7 shows no monotonic decrease in artifact discovery rates through the season as might be expected if crew members are being bored with or fatigued by their task. Several modulating factors may be intervening here. For one thing, because we are limited to considering only the non-gridded units, we have very few data points with which to track surveyor performance. In addition to this, the membership of the survey crew was not constant through the season. Thus, for some survey crew members, there are only one or two points, with a maximum of 6 data points for any one crew member. And, of course, if the discovery crew members were becoming fatigued or bored near the end of the season, it is also quite likely that analysis crew members were experiencing similar problems, which might also negatively affect the number of "post-discovery crew discoveries." We suspect that because crew members were constantly rotated through different crews and tasks, the impact of fatigue or boredom should be slight and, indeed, there is little evidence that such factors are at work in these data.

What Table 5.15 does show, however, is that, except for early in the field season and except for isolated cases, the artifact discovery rates for crew members are remarkably similar for each survey day. Of special interest, however, is that artifact discovery rates shifts en masse from day-to-day (see especially March 16 versus March 31 versus April 24). This trend implicates some other global factor, such as density of artifacts within the unit, as driving the variability seen in these discovery rates for individuals.

Finally, in Table 5.16 and Figure 5.8 artifact discovery rates are considered by time of day for discovery crew members. Note, again, that the number of transects completed in the early morning or late afternoon, and apparently the number of artifacts that could have been found on those early morning or late afternoon transects (see Table 5.16 for total percent of "discoverable" artifacts by time of day), is very low. The seemingly wild fluctuations in individual diurnal artifact discovery rates and the disagreements between individuals in artifact discovery rates for those times is probably spurious. Of interest, again, however, is the fairly tight clustering of artifact recovery rates within about 5 percent of each other for crew members in the late morning and early afternoon. Also, Discoverer 2 has a much higher artifact discovery rate than most, especially in the late morning.

It is obvious that some real differences between crew members, as measured here, do exist. Archaeologists are limited by their capabilities, personalities, and training in the kind of archaeology they can see. While no substantive evidence of the negative effects of fatigue or boredom could be detected in these data, it is suspected that should this effect have been at work, it would have been overwhelmed by the shortcomings of the data base. The implications of these differences for distributional archaeology, if they persist through future studies of this sort, are simple. Obviously, if one individual finds a remarkably different archaeology than everyone else, either by missing objects or by finding many more than others, the consistency of the archaeological record is compromised.

The questions become: How different is too different? Can a data base which has this fundamental bias built into it, and all archaeological survey results are subject to this bias, be "corrected?" And, is there some way to anticipate what the artifact discovery rate of an individual will be and take preventative measures? The answer to the first question is,

Table 5.15. Daily artifact discovery percentages for those discovery crew members who surveyed 2 or more days.

	DATE							Artifacts		
Discoverer	1-08	3-05	3-14	3-15	3-16	3-31	4-24	Discov	Total	Percent
1		73	62		78		61	704	1035	68
3		76		44	72	61	73	837	1219	67
5	74	68	60	85		56	65	969	1517	64
2			77	80	86			292	350	83
7						56	73	523	811	65
6	74	70	63	83	79			656	910	72
4	61	70	61	89	74	54		721	1119	64

			CHIPPED STONE TYPE							
CODER	Tst Cob/ Chunk	Core	Anglr Debris	Distl Flake	Pltfrm Flake	Uniface	Biface	Proj Point	Indetrm/ Unknown	TOTAL
1	208	121	520	148	1210	18	25	0	0	2,260
	127.0	83.9	583.0	183.8	1225.0	24.5	21.0	10.3	1.5	
	51.7	16.4	6.8	7.0	0.2	1.7	0.8	0.0	1.5	86.1
3	88	49	653	229	862	19	15	7	6	1,928
	108.3	71.5	497.4	156.8	1045.1	20.9	17.9	8.8	1.3	
	3.8	7.1	48.7	33.3	32.1	0.2	0.5	0.4	17.9	144.0
5	83	71	443	247	1609	32	22	15	2	2,524
	141.8	93.7	651.1	205.2	1368.1	27.4	23.5	11.5	1.6	
	24.4	5.5	66.5	8.5	42.4	0.8	0.1	1.0	0.1	149.3
9	81	72	304	19	733	9	7	6	0	1,231
	69.2	45.7	317.6	100.1	667.3	13.4	11.4	5.6	0.8	
	2.0	15.2	0.6	65.7	6.5	1.4	1.7	0.0	0.8	93.9
2	82	18	509	66	557	11	6	3	0	1,252
	70.4	46.5	323.0	101.8	678.6	13.6	11.6	5.7	0.8	
	1.9	17.4	107.1	12.6	21.8	0.5	2.7	1.3	0.8	166.1
8	115	92	459	268	1096	30	20	9	0	2,089
	117.4	77.5	538.9	169.9	1132.3	22.7	19.4	9.5	1.4	
	0.0	2.7	11.8	56.7	1.2	2.4	0.0	0.0	1.4	76.2
7	32	32	275	20	579	14	19	6	0	977
	54.9	36.3	252.0	79.4	529.6	10.6	9.1	4.5	0.6	
	9.6	0.5	2.1	44.5	4.6	1.1	10.8	0.5	0.6	74.3
TOTAL	689	455	3163	997	6646	133	114	56	8	12261
	90.4	64.8	243.6	228.3	108.8	8.1	16.6	3.2	23.1	789.9

Table 5.16. Artifact discovery percentages for discovery crew members who surveyed 2 or more days by the time of day the tranbect was completed.

Crew Person	before 9:30	9:30 - 12:00	12:00 - 2:30	after 2:30
Discoverer 1	40	71	68	50
Discoverer 3	83	69	66	62
Discoverer 5	79	64	63	63
Discoverer 2	76	60	66	69
Discoverer 7	72	60	66	69
Discoverer 6	88	71	72	89
Discoverer 4	57	61	67	89
Crew	71	68	67	89

Of 6,923 Artifacts that could have been discovered, the percent found according to time of day:

2	46	51	1

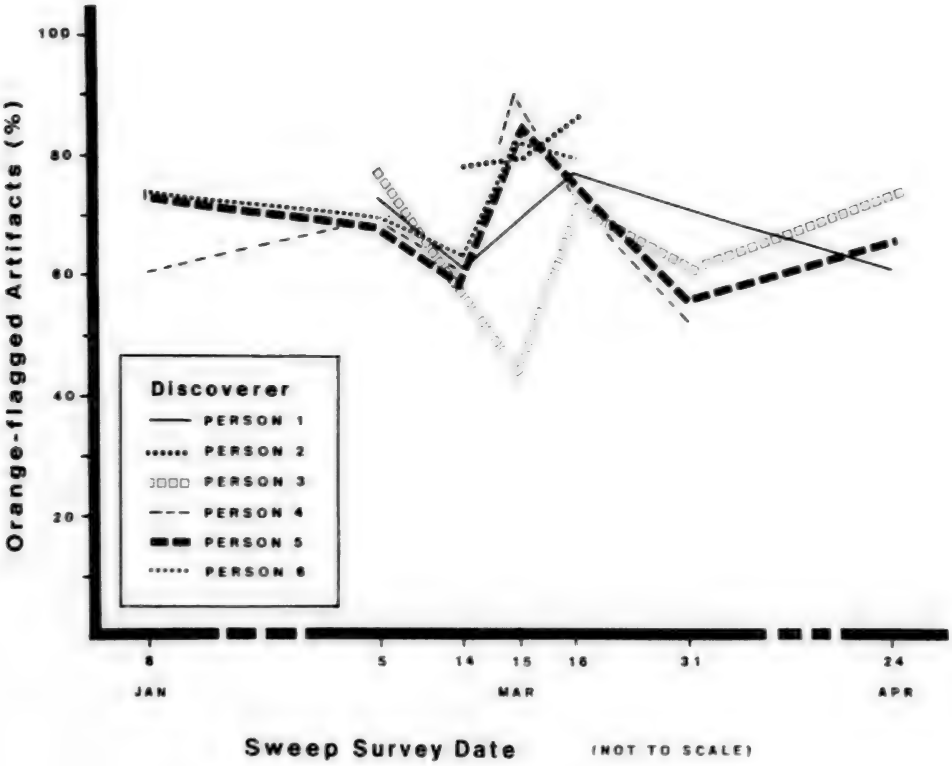


FIGURE 5-7.

PERCENT ARTIFACTS DISCOVERED VS DATE FOR INDIVIDUAL DISCOVERY CREW MEMBERS.

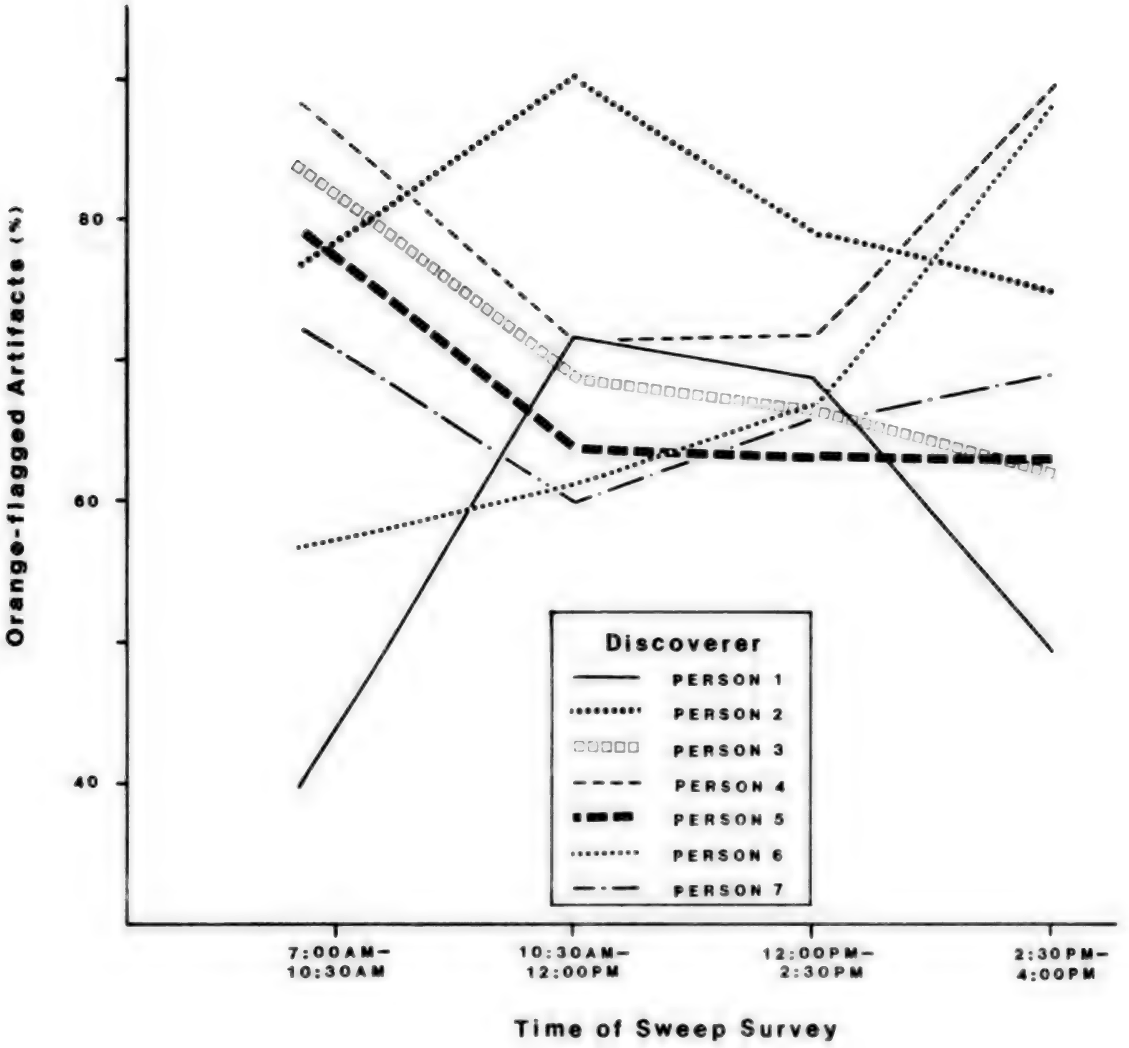


FIGURE 5-8.

PERCENT ARTIFACTS DISCOVERED VS TIME OF DAY FOR INDIVIDUAL DISCOVERY CREW MEMBERS.

147

of course, that it depends on the type of analyses to be conducted with the data base and the sensitivity of those analyses to consistency of the data base at the scale of the idiosyncrasies of the individual surveyor. In other words, each analysis of such a data base requires its own assessment of consistency. To answer the second and third would require a more in depth comparison of which sorts of artifacts are being discovered by which sorts of individuals. Such a comparison requires a data base for which there is assurance that surveyor A actually did miss or did find an artifact. For this sort of comparison, each discovery crew position would be required to be assigned a unique flag color, as future applications of distributional archaeology will mandate. As contributions to the resolution of all of these questions, further investigations of this genre must be examined, to establish a baseline of information with respect to the reproducibility of these results.

Discovery Accuracy: Implications and Conclusions

The results of the above exploratory investigations into the representativeness and consistency of the data base, with respect to the potential surface archaeology, and, hence, the accuracy and precision of the survey procedure is more provocative than definitive. Several general statements are possible, however, and relate to the spatial scale at which the archaeological record contained in the NHLEP data base is representative.

Considering the entire data base of spatial and descriptive artifact attributes as our record of one very large assemblage of artifacts, certainly this record must come closer than any other more traditionally-derived data base in reflecting the cultural remains presently on the West Mesa surface. Even broken down to individual survey units, the record for each is a much more satisfying representation of the cultural remains present on the surface than previously conducted surveys which tell us how many limited activity scatters there are. However, given the positive relationship between artifact size and artifact discovery documented here, the contribution of artifact coloration to this relationship, and the spotty coverage of the unit with the second pass by the analysis crew, it must be concluded that this data base is not fully accurate with respect to the distribution of artifact size at a smaller spatial scale. In areas with high artifact density, the artifact size distribution is probably well represented. In low artifact density areas, however, the data base is less consistent with respect to spatial configuration and size distribution (and coloration) of artifacts. That is, while probably most large and dark-colored artifacts were recovered even in low density areas, the recording of small artifacts, especially light-colored small artifacts, in such areas was variable.

The precision of the discovery procedure, and hence the consistency of the data base, was only briefly touched upon in this analysis. Definite evidence was found that it is influenced by environmental factors such as wind intensity and, to a lesser extent, temperature. Also found was robust patterning in artifact recovery rates with respect to time of the day that the sweep was completed. At this point, it is not sure if this result is an artifact of cycling in crew attentiveness or in light quality.

It was found that most crew members seem to be sensitive to artifact obtrusiveness to the same degree and that there is little marked systematic variability in crew member performance through the season or through the day. There is some indication that surveyor interest and familiarity with survey techniques may influence discovery performance. It is suspected that future analyses of this sort which are able to track the performance of all crew members through the entire season, i.e., are not subject to some of the limitations our data base is subject to, will be able to better isolate differences in discovery rates which may be due to experience and interest.

While some information about survey precision has been collected, this question can best be explored through the institution of a seeding program in which a predetermined amount of contemporary material, preferably with disparate size classes, is introduced into a unit prior to its survey. For example, 100 items 15 millimeters in size, 100 40 millimeters in size, and 100 of 75 mm in size, half with a color contrasting to the unit sediments and the other half with color similar to the sediments in the unit, could be introduced in an unsystematic fashion into units immediately preceding their survey. By unsystematic introduction, using a true random walk (randomly derived distance and angle) is visualized within the unit coupled with broadcasting of small numbers of the calibration artifacts at each juncture in the random walk.

With the calibration artifacts in place, survey would proceed as conducted here with every artifact, modern and prehistoric, being flagged. In the course of surveying the Seedskadee seeded unit, the crew chief observed that the search for modern "pseudo-facts" caused the discovery crew to be more diligent and resulted, it was his feeling, in the discovery of more prehistoric items than would have been the case had the washers and nails not been there (Wandsnider and Ebert 1984). It is suspected that a discovery crew surveying a unit which was already known to contain at least 300 items would be seized by a similar alertness. The calibration artifacts would be recorded by the encoding crew during the attribute analysis phase as to size and color. Spatial coordinates for the calibration artifacts would be unnecessary since this was not controlled for during the process of introduction.

With information on the recovery of both prehistoric and calibration artifacts, it would be possible to know, for example, that in low density units 50 percent of the dark-colored 15 millimeter items, 40 percent of light-colored 15 millimeter items, 90 percent of dark-colored 75 millimeter items, and 85 percent of light-colored 75 millimeter items were found. While in high density units, 70 percent of the dark-colored 15 millimeter items, 40 percent of light-colored 15 millimeter items, 100 percent of dark-colored 75 millimeter items, and 95 percent of the light-colored 75 millimeter items were discovered. These hypothetical results, which are probably not too far removed from reality given the survey results and those of the Seedskadee discovery accuracy test, would suggest assemblage analyses which compare units of similar density and the stratification of assemblages for analysis into size classes. Alternatively, such results might be used to mandate resurvey of a unit until acceptable percentages of the calibration artifacts are recovered.

This analysis of survey accuracy has serious implications for the interpretation of survey results conducted with traditional methods. It was found that while dark-colored, large items are the most easily found, small, light-colored items are more easily overlooked. Given this, it might be expected that a site inventory derived through traditional survey for this area would be impoverished with respect to locations with biface manufacturing with materials like chalcedony, and that places with crystalline volcanic groundstone (rare in this data) might be over-represented. Further, the recognition of intensive recycling, which leads to an artifact size distribution skewed to small items, would be checked. And, given these discovery biases, it should not be surprising that the archaeology of the West Mesa, which would be characterized as low density but continuous, is considered sparse by others.

ARTIFACT CODING PRECISION

The quality of the NHLEP data base is dependent not only upon the completeness of artifact discovery, but also upon aspects of artifact attribute coding. These include the sensitivity of the attributes to the aspects of land use diagnostics and consistency with which those attributes can be coded by members of the analysis crew. This next section is concerned with the consistency in lithic artifact attribute coding.

Table 5.17 shows how seven chipped stone analysts, responsible for coding 95 percent of the 12,924 pieces of NHLEP chipped stone, recorded gross, raw material type. In addition to frequencies, Table 5.17 gives for each coder and material the deviation of the observed from the expected given the total number of items coded for a certain material type (column sum) and for each coder (row sum). For example, Coder 1 recorded 75 glassy volcanic artifacts, which is very close to the 76 Coder 1 is expected to have recorded given the total number of glassy volcanic artifacts coded and the number of artifacts Coder 1 coded. From this, the conclusion is made that Coder 1's coding of glassy volcanics seems to be very consistent with how other members of the encoding crew recorded glassy volcanic material type. In general, gross raw material type is consistently coded with glassy volcanics, sandstone, and cryptocrystallines (like chert) showing little intercoder variation (refer to the column Chi-square sums) and crystalline volcanics,

Table 5.17. Distribution of chipped stone raw material type codes among principal lithic analysts for NHLEP chipped stone data base.

	GROSS MATERIAL TYPE						
CODER	Glss Volcn	Crystl Volcn	Crypto crystln	Quart zite	Sand stone	Other	TOTAL
1	75	629	1100	292	137	27	2,260
	75.9	680.3	1165.3	168.5	94.6	75.4	
	0.0	3.9	3.7	90.6	19.0	31.1	148.3
3	63	506	1047	114	73	125	1,928
	64.8	580.4	994.1	143.7	80.7	64.3	
	0.0	9.5	2.8	6.1	0.7	57.3	76.4
5	76	660	1297	248	116	127	2,524
	84.8	759.8	1301.4	188.2	105.6	84.2	
	0.9	13.1	0.0	19.0	1.0	21.8	55.8
9	30	346	718	84	33	20	1,231
	41.4	370.6	634.7	91.8	51.5	41.1	
	3.1	1.6	10.9	0.7	6.6	10.8	33.7
2	55	609	480	45	43	20	1,252
	42.1	376.9	645.6	93.3	52.4	41.8	
	4.0	142.9	42.5	25.0	1.7	11.3	227.4
8	70	700	1064	87	101	67	2,089
	70.2	628.9	1077.1	155.7	87.4	69.7	
	0.0	8.0	0.2	30.3	2.1	0.1	40.7
7	43	241	616	44	10	23	977
	32.8	294.1	503.8	72.8	40.9	32.6	
	3.2	9.6	25.0	11.4	23.3	2.8	75.3
TOTAL	412	3691	6322	914	513	409	12,261
	11.2	188.6	85.1	183.1	54.4	135.2	657.6

NOTE: First entry is the observed frequency, second entry is expected frequency given row and column totals, and third entry is the contribution of the cell to the overall Chi-square (thus representing the deviation of observed from expected). Row and column Chi-square sums are also given.

quartzites, and other unspecified raw material types showing the most amount of variability.

Lithic analysts coding raw material at variance with other coders include: Coder 2, who is responsible for more than a third of the variability in this distribution (refer to row sums of Chi-square values) and who records more crystalline volcanic than expected; Coder 1, who records more quartzite than expected; Coder 7, who records more cryptocrystallines and less sandstone than expected; Coder 3, who records more "other" material type than everyone else. Coder 5 and Coder 8, who between them coded more than one-third of the NHLEP chipped stone, in general recorded material types very consistently. Coder 8, however, did record half as much quartzite chipped stone as expected.

Table 5.18 summarizes how individual analysts coded chipped stone type for NHLEP chipped stone. The consistency of the type designation, while not as great as that for gross raw material type (the Chi-square value of the former is 790, while that of the latter is 658), varies as might be expected given the working definitions of the types and the potential to make type distinctions under field conditions. For example, unifaces, bifaces, and projectile points have the most closely specified identification criteria (see Chapter 6) and show relatively little intercoder variability (refer to the column Chi-square sums).

Several types show a moderate amount of intercoder variability. The definition of core as a piece of material which exhibits no bulb of percussion and which has two or more negative flake scars at least 2 centimeters long which originate from one or two surfaces (see Chapter 6) is a definition which also could include unifaces and bifaces. This is the major reason suspected for the variability in the identification of the type core and, indeed, as later analyses show, there is robust patterning in the typing of cores versus unifaces versus bifaces according to analyst. There is also relatively high amounts of variability in the typing of chunk/cobbles (a surficially unmodified cobble or piece of lithic material) and tested cobbles (cobbles from which one or two flakes have been removed as though to ascertain the quality of the lithic material for chipped stone manufacturing). Distinguishing between these types and angular debris (debitage on which no ventral surface can be defined but which does exhibit unquestionable negative scars), for example, rests on the decision about the extent and nature of flake scars present on the item. Similar decisions must be made to type an artifact as a platform-bearing flake (lithic artifact with dorsal and ventral side, and with bulb of percussion and platform), for which there is also a moderate amount of intercoder inconsistency.

The chipped stone types angular debris and distal flake fragments show the most amount of intercoder variability. We suspect this variability is related to the experience of the analyst in identifying the critical attributes of flake morphology as discussed below.

There are some propensities in how individual coders recorded chipped stone type. Coder 2, for example, overcodes angular debris at the apparent expense of flakes, platform-bearing or distal. Coder 5, on the other hand, codes more flakes and codes fewer angular debris. Coder 3 overcodes angular debris and distal flake fragments and also codes high frequencies of chipped stone type Unknown or Indeterminate. Coder 1 appears to overcode chunks/cobbles/tested cobbles and undercodes angular debris and distal flake fragments. Coder 7 and Coder 8 appear to fall within the extremes of the other analysts with respect to chipped stone codes.

These seeming deviations in type coding may be due to the fact that different frequencies of such items were encountered and coded by analysts, or to the capabilities and tendencies of the coders themselves, or to the degree of latitude in interpretation afforded by type definitions. Evidence for the importance of lithic analysis experience comes from Table 5.19 which contrasts experience versus codes for angular debris, distal flake, and platform-bearing flake. Inexperienced coders (Coder 3, Coder 9, Coder 2, and Coder 7) code more angular debris than flakes (either distal or platform-bearing). Analysts with more experience (Coder 1, Coder 5, and Coder 8) record more than the expected number of flakes (proximal or distal).

The influence of experience on coder consistency is further supported by Table 5.20 and Table 5.21

Table 5.18. Distribution of chipped stone type codes among principal lithic analysts for NHLEP chipped stone data base.

CHIPPED STONE TYPE

CODER	Tst Cob/ Chunk	Core	Anglr Debris	Distl Flake	Pltfrm Flake	Uniface	Biface	Proj Point	Indetrm/ Unknown	TOTAL
Camilli	208	121	520	148	1210	18	25	10	0	2260
	127.0	83.9	583.0	183.8	1225.0	24.5	21.0	10.3	1.5	
	51.7	16.4	6.8	7.0	0.2	1.7	0.8	0.0	1.5	86.1
Niles	88	49	653	229	862	19	15	7	6	1928
	108.3	71.5	497.4	156.8	1045.1	20.9	17.9	8.8	1.3	
	3.8	7.1	48.7	33.3	32.1	0.2	0.5	0.4	17.9	144.0
Simons	83	71	443	247	1609	32	22	15	2	2524
	141.8	93.7	651.1	205.2	1368.1	27.4	23.5	11.5	1.6	
	24.4	5.5	66.5	8.5	42.4	0.8	0.1	1.0	0.1	149.3
Pike	81	72	304	19	733	9	7	6	0	1231
	69.2	45.7	317.6	100.1	667.3	13.4	11.4	5.6	0.8	
	2.0	15.2	0.6	65.7	6.5	1.4	1.7	0.0	0.8	93.9
Kayser	82	18	509	66	557	11	6	3	0	1252
	70.4	46.5	323.0	101.8	678.6	13.6	11.6	5.7	0.8	
	1.9	17.4	107.1	12.6	21.8	0.5	2.7	1.3	0.8	166.1
Larralde	115	92	459	268	1096	30	20	9	0	2089
	117.4	77.5	538.9	169.9	1132.3	22.7	19.4	9.5	1.4	
	0.0	2.7	11.8	56.7	1.2	2.4	0.0	0.0	1.4	76.2
Wase	32	32	275	20	579	14	19	6	0	977
	54.9	36.3	252.0	79.4	529.6	10.6	9.1	4.5	0.6	
	9.6	0.5	2.1	44.5	4.6	1.1	10.8	0.5	0.6	74.3
TOTAL	689	455	3163	997	6646	133	114	56	8	12261
	90.4	64.8	243.6	228.3	108.8	8.1	16.6	3.2	23.1	789.9

NOTE: First entry is the observed frequency, second entry is expected frequency given row and column totals, and third entry is the contribution of the cell to the overall Chi-square (thus representing the deviation of observed from expected). Row and column Chi-square sums are also given.

Table 5.19. Distribution of (a) angular debris and flakes (distal and proximal), and (b) angular debris, distal flakes fragments, and platform-bearing flakes according to coder experience.

(a)

ANALYST	Angular Debris	Flake (Distal or Proximal)	TOTAL
Experienced	1,422	4,578	6,000
Inexperienced	1,741	3,065	4,806
TOTAL	3,163	7,643	10,806

NOTE: Chi-square is 202.22 which is more than the critical value of 10.83 (1 degree freedom) at a significance level of 0.001.

(b)

ANALYST	Angular Debris	Distal Flake	Platform-Bearing Flake	TOTAL
Experienced	1,422	663	3,915	6,000
Inexperienced	1,741	334	2,731	4,806
TOTAL	3,163	997	6,646	10,806

NOTE: Chi-square is 222.46 which is more than the critical value of 13.82 (1 degree freedom) at a significance level of 0.001.

Table 5.20. Distribution of chipped stone flake and debitage edge utilization/modification/accessorization codes among principal lithic analysts for NHLEP chipped stone data base.

CODER	Absent	Present	TOTAL	Utilization	Modification	Accessorized	TOTAL
1	1,671	207	1,878	140	57	10	207
	1,749.6	128.4		106.7	92.7	7.6	
	3.5	48.1	51.6	10.4	13.8	0.8	25.0
3	1,647	97	1,744	40	56	1	97
	1,624.7	119.3		50.0	43.4	3.5	
	0.3	4.2	4.5	2.0	3.6	1.8	7.4
5	2,120	179	2,299	61	109	9	179
	2,141.8	157.2		92.3	80.2	6.5	
	0.2	3.0	3.2	10.6	10.4	0.9	21.9
9	1,015	41	1,056	26	14	1	41
	983.8	72.2		21.1	18.4	1.5	
	1.0	13.5	14.5	1.1	1.0	0.2	2.3
2	1,069	63	1132	45	17	1	63
	1,054.6	77.4		32.5	28.2	2.3	
	0.2	2.7	2.9	4.8	4.5	0.7	10.0
8	1,713	110	1823	32	75	3	110
	1,698.3	124.7		56.7	49.3	4.0	
	0.1	1.7	1.8	10.8	13.4	0.3	24.5
7	832	42	874	37	3	2	42
	814.2	59.8		21.7	18.8	1.5	
	0.4	5.3	5.7	10.9	13.3	0.1	24.3
TOTAL	10,067	739	10,806	381	331	27	739
	5.7	78.5	84.2	50.6	60.0	4.8	115.4

NOTE: First entry is the observed frequency, second entry is expected frequency given row and column totals, and third entry is the contribution of the cell to the overall Chi-square (thus representing the deviation of observed from expected). Row and column Chi-square sums are also given.

154

Table 5.21. Chi-square evaluation of distribution of edge utilization/modification codes among experienced and inexperienced lithic analysts in terms of (a) presence/absence of modification and (b) kind of modification.

(a) UTILIZATION/MODIFICATION

	Absent	Present	TOTAL
Experienced	5,504	496	6,000
Inexperienced	4,563	243	4,806
TOTAL	10,067	739	10,806

NOTE: Chi-square value of 43.17 which is greater than the critical value of 10.83 (1 degree dreedome) at the 0.001 significance level.

(b) UTILIZATION/MODIFICATION

ANALYST	Utilization	Modification	Accessorization	TOTAL
Experienced	233	241	22	496
Inexperienced	148	90	5	243
TOTAL	381	331	27	739

NOTE: Chi-square value of 13.52 which is greater than the critical value of 10.60 (2 degree freedome) at the 0.0005 significance level.

which consider how frequently coders identified utilization (edge "damage" less than 2 millimeters from the edge), modification (edge "damage" 2 millimeters from edge to 1/3 of the tool surface), and "accessorization" (special edge features like notches and gravers) on debitage. In general, the inexperienced coders (Coder 3, Coder 9, Coder 2, and Coder 7) find low incidence of any kind of edge damage. Coder 8, an experienced analyst, records slightly less, and Coder 5 and especially Coder 1 record more than expected edge damage attributable to utilization or modification. Considering how the experienced coders analyzed edge damage, Table 5.20 shows that Coder 1 codes more utilization and accessorization and less modification. Conversely, Coder 5 and Coder 8 code more modification and less utilization or accessorization. Coder 3, an inexperienced analyst codes more than expected edge modification while all of the other inexperienced analysts seem to code utilization. Table 5.21 collapses experienced and inexperienced analysts into their respective categories and summarizes these significantly nonrandom trends. It is unlikely that these particular trends are due to artifact sampling error. That is, that inexperienced analysts just happen to find fewer flakes without edge damage than experienced analysts seems possible, but highly improbable.

As one way objectively measure the consistency of the chipped stone data base and, hence, the precision of the artifact coding procedure, a consistency test, similar in design to that of Larralde (1984) was performed. After coming out of the field, the seven coders, who together were responsible for coding 95 percent of the NHLEP chipped stone, were given a test assemblage of 200 items derived from collected specimens. Members of the test assemblage included approximately 50 problematic artifacts, while the rest of the assemblage was, at least impressionistically, representative of the sorts of artifacts (and non-artifacts) encountered in the field. Under laboratory conditions, the coders were instructed to code the artifacts as they had during the course of the field project (see Chapter 6 for coding form).

In analysis of coder consistency, Larralde (1984) found artifact metric measurements to be the most precise and ordinal variables, such as artifact breakage, with well defined variables states to show a great deal of consistency. Disagreement among the three analysts Larralde evaluated was especially large for chipped stone artifact type and for the six interval ordinal variable describing percent surface modification and percent edge modification.

Table 5-22 summarizes the amount of agreement among 7 chipped stone analysts, 3 experienced and 4 inexperienced, who coded raw material type in the test assemblage. This table shows one way to present information on consistency, namely, the percentage of artifacts for which different numbers of material types were coded for the entire assemblage. Forty-nine percent of the 200 chipped stone artifacts were coded for the same raw material type when considering all 26 raw material types. When these 26 material types are collapsed into 6 gross material types, 72 percent of the artifacts are coded for the same material type, which is an incredibly high amount of agreement among seven archaeologists. In general, when considering all 26 material types, there is more disagreement than when just 6 collapsed material types. This is consistent with findings by Fish (1978), De Boer (1980), and Larralde (1984), who each note that the more intervals or categories there are to classify an object into, the greater the disagreement. Of further interest is the fact that when at least one analyst (usually an inexperienced analyst) coded the material type as being indeterminate or otherwise unknown, the disagreement among the other coders was significantly higher. This pattern suggests that the "Indeterminate" and "Unknown" codes are perfectly legitimate, and perhaps should have been used more liberally by other analysts.

There are several disadvantages to presenting consistency information in a format similar to Table 5.22. One of these is that it is impossible to evaluate the distribution of disagreement among analysts without knowing what the assemblage actually consists of. For example, if the raw material of the test assemblage was solely cherts and obsidian, then the amount of disagreement given in Table 5.22 would be truly alarming since it would indicate that some analysts cannot identify materials as unique in their properties as obsidian or chert. On the other hand, if the test assemblage contained only cryptocrystalline volcanics and slightly metamorphosed sedimentary or volcanic materials, than the results presented in Table 5.22 would be highly encouraging. They could then be interpreted to mean that even difficult to distinguish material types were being discriminated. The "truth" about raw materials in the test assemblage is not known, however, and so the amount of disagreement summarized in Table 5.22 cannot be fully appreciated.

A second disadvantage to this presentation format is that it does not allow identification of individual trends in coding. Therefore, this analysis concentrates on the individual analyst in comparison to the other analysts and assumes that the "truth" about what the test assemblage actually consists of lies somewhere in the midst of how this group of analysts coded the assemblage.

The ability of lithic analysts to make consistent and accurate attribute identifications depends not only on the exclusiveness of the attribute definitions, but also on the familiarity of the analysts with those attributes. Patterning in artifact attribute coding within the NHLEP chipped stone data base has been identified by experienced and inexperienced analysts and this perspective has been continued in analyzing the test assemblage. This analysis of artifact coding consistency has two parts: (1) the investigation of the consistency of artifact attribute coding of three experienced coders and (2) the comparison of coding trends between the less-experienced coders and the more-experienced

Table 5.22. Number of different material type codes coded by 7 coders for 26 possible material types and 6 collapsed material type categories.

	RAW MATERIAL					
Number of	26 Types			6 Type Categories*		
Codes	Total	(1)	(2)	Total	(1)	(2)
1	99 (49%)	99	0	145 (72%)	145	0
2	59 (29%)	58	1	39 (19%)	35	4
3	23 (11%)	20	3	14 (7%)	8	6
4	15 (7%)	7	8	2 (1%)	0	2
5	3 (1%)	3	0	1 (1%)	0	1
6	1 (1%)	0	1	0		
7	1 (1%)	1	0	0		

NOTES: *Glassy volcanic, crystalline volcanic, cherts and other cryptocrystalline sedimentary, quartzite, sandstone, and other (metamorphic, miscellaneous).

(1) Artifacts for which no coder coded material type 80 (other material type) or 99 (indeterminate material type).

(2) Artifacts for which at least one coder coded material type 80 or 99.

coders, who trained the former. Finally, the relative amounts of error in the NHLEP chipped stone data base due to individual coder are identified.

In the following, tables similar to Tables 5.17, 5.18, and 5.20 are used to explore the nature of variability in the test assemblage. These tables should be referred to since through examination of the deviations of the observed frequencies (for any coder or any variable code) from the expected, it is easy to infer the relative consistency of both codes and coders. The cell Chi-square value for each coder and variable gives the contribution of that cell to the overall Chi-square value for the distribution. A small cell Chi-square, relative to the total Chi-square, indicates that the coder and variable state shows consistency while a large cell Chi-square value of course indicates the opposite. The column sums of the cell Chi-squares thus monitor the amount of consistency with which a given variable state is coded. Row sums of the cell Chi-squares inform on coder consistency.

Table 5.23 presents the big picture of chipped stone coding consistency for each of five continuous variables and six discrete variables for experienced and inexperienced coders. Consistency is high for both experienced and inexperienced coders for metric variables such as length, width, and thickness, and for gross material type. For all analysts, both experienced and inexperienced, dorsal scar count, chipped stone type, flake completeness, and flake platform show relatively high amounts of coding variability, although experienced coders display less of this inconsistency than do inexperienced analyst. For experienced analysts, the stage index (a composite index describing the reduction stage of a flake, 0 being early and 10 being late; see Chapter 6) and amount of dorsal cortex are fairly consistently coded, but this is not the case for inexperienced coders. The following analyses explore in more detail these coding tendencies.

Experienced Analysts

Table 5.24 facilitates the comparison of the experienced chipped stone analysts with respect to various metric measurements, like artifact length, width, and thickness, an almost-continuous variable, dorsal scar count (which ranges from 0 to 9, 9 meaning 9 or greater dorsal scars), and the stage index, which ranges from 0 to 10. Note that only those artifacts which each of the three analysts coded for a particular attribute are included in these analyses. That is, if for a certain artifact Coder 1 and Coder 5 recorded length, but Coder 8 codes only a size class, then that artifact does not take part in the analysis comparing length codes. If, however, all analysts coded number of dorsal scars on that same artifact, then that item would be included in the dorsal scar count analysis.

As Table 5.24 shows, the degree of consistency in the coding of metric attributes by the experienced coders is very high with a difference in the coder means of 2 millimeters for length, less than 2 millimeters for width, and less than 1 millimeter for thickness. With respect to metric measurements, Coder 1 consistently measures low compared with the other coders, while Coder 5 is high for thickness and width.

The consistency of dorsal scar count coding, while high, is somewhat less than that for the metric measurements. Coder 1 and Coder 8 apparently record dorsal scar count consistently and the difference in the dorsal scar count means between these two coders is less than 0.4 dorsal scars. Coder 5 records higher dorsal flake scar counts than either Coder 1 or Coder 8, and this difference amounts to more than 0.6 dorsal scars, which is significant at the 0.05 level. Dorsal flake scars occur in a range of sizes and no consistently applied size threshold was used to discriminate between "countable" versus "uncountable" flake scars. It is therefore possible that Coder 5 used a slightly smaller flake scar size threshold and thus counted more dorsal flake scars. However, that coders agree on dorsal scar count to within less than one flake scar (on average) is unexpected good news.

Interestingly, coder extremes (which indeed are not very extreme) seem to balance each other since the mean stage index, which is a composite index based on flake thickness, relative amount of dorsal scars, amount of cortex and type of platform (see Chapter 6), for each individual is about the same. Among the three experienced coders, the mean stage index varies by only 0.137.

Table 5.23. Summary of chipped stone coding consistency by coder experience and chipped stone code.

CHIPPED STONE VARIABLE	CHIPPED STONE ANALYSTS	
	Experienced	Inexperienced
CONTINUOUS VARIABLES		
Length	1.10	0.27
	2	4
	0.3336	0.8966
Width	0.43	0.56
	2	4
	0.6509	0.6892
Thickness	1.03	0.82
	2	4
	0.3593	0.5100
Stage	0.09	2.98
	2	4
	0.9107	0.0212
Dorsal Scar Count	6.72	6.32
	2	4
	0.0014	0.0001
DISCRETE VARIABLES		
Gross Raw Material Type	8.927	17.841
	10	20
	0.5390	0.5979
Chipped Stone Type *	33.909	59.840
	10	20
	$<$0.0010	$<$0.0010
Flake Completeness	28.386	97.953
	8	16
	0.0004	0.0001
Flake Platform #	22.470	55.937
	6	12
	0.0010	$<$0.0010
Flake Dorsal Cortex	9.052	25.256
	8	16
	0.3379	0.0654

NOTES: *To reduce sparseness (see Tables 5-26 and 5-39), types chunk/tested cobble/cobble, distal flake fragment, indeterminate, and groundstone, were collapsed into a single category of "other."

#To reduce sparseness (see Tables 5-26 and 5-39), platform codes missing, ground, other, and indeterminate were collapsed into a single category of "other."

(a) For continuous variables, the first entry is the Analysis of Variance F statistic, the second entry is degrees freedom, and the third entry is the probability of obtaining a higher F statistic. For discrete variables, the first entry is overall Chi-square value, second entry is the degrees freedom, and third entry is the probability of obtaining a higher Chi-square value.

Table 5-24. Analysis of Variance and Tukey's Studentized Range Test for continuous chipped stone variables comparing experienced coders.

CONTINUOUS VARIABLE MEANS

Coder	Length	Width	Thick	DSC	Stage
1	26.904	25.921	7.342	3.226	4.923
8	29.158	26.465	7.965	2.978	4.859
5	27.228	27.781	8.132	* 3.839	4.996
N	114	114	114	93	44
ANALYSIS OF VARIANCE					
F Value	1.10	0.43	1.03	6.72	0.09
Probability of larger F	.333	.651	.359	.001	.911
TUKEY'S STUDENTIZED RANGE TEST					
Critical Value at alpha=.05	3.329	3.329	3.329	3.333	3.353
Minimum Significant Difference	3.865	4.854	1.367	0.569	0.753

NOTE: *significantly different at the 0.05 significance level

This analysis provides an indication of how much variability between assemblages may be due to measurement error. For example, to compare the mean lengths of two different assemblages, a difference of 3.86 millimeters (the mean significant difference; [MSD]) could be attributable to the fact that one individual coded the majority of one assemblage while another individual coded most of the other assemblage to which the first is being compared. Thus, differences in mean lengths between any two assemblages which are greater than 3.86 could be said to be due to the character of the assemblage, and not to coder idiosyncrasies. Note that these measures of MSD are probably fairly liberal in that most of the analytically-defined assemblages discussed in succeeding analyses were coded by more than one analyst and therefore should represent the averaging of coder extremes. This means that if MSDs are used to make judgements on the similarity of or difference between assemblages, it will more often be the case that differences between assemblages not attributable to coder error will be identified and that some significant differences between assemblages will be discounted because they are not at the MSD threshold.

As already mentioned in the discussion of Table 5.17, there are no significant differences in how material type is coded either among experienced or inexperienced analysts. Table 5.25 reiterates this trend (note the very small total Chi-square value of 9.0) and again shows (see Table 5.17) that crystalline volcanics and quartzite are the more problematic material types. Of the experienced analysts, Coder 8 codes somewhat more artifacts as being of crystalline volcanic material then do Coder 1 and Coder 5, at the apparent expense of the cryptocrystalline material (i.e., cherts) and quartzite.

In Table 5.18, which presented the distribution of type codes among all seven coders within the NHLEP chipped stone data base, the types "angular debris" and "distal flake fragments" showed the most amount of variability. Table 5.26 considers chipped stone type as well as the number of items in the test assemblage coded with groundstone

Table 5.25. Distribution of gross material type codes among experienced coders within test assemblage.

	GROSS MATERIAL TYPE						
CODER	Glass Volcn	Crystl Volcn	Crypto Crystl	Ouartzite	Sandstone	Indetrm Unknown	TOTAL
EXPECTED	30.7	44.3	105.7	11.7	2.7	5.0	
1	31	39	109	14	3	4	200
	0.0	0.6	0.1	0.5	0.0	0.2	1.4
5	30	38	110	14	3	5	200
	0.0	0.9	0.2	0.5	0.0	0.0	1.6
8	31	56	98	7	2	6	200
	0.0	3.1	0.6	1.9	0.2	0.2	6.0
TOTAL	92	133	317	35	8	15	600
	0.0	4.6	0.9	2.9	0.2	0.4	9.0

NOTE: Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

attributes. It shows there to be some inconsistency in how angular debris was coded, but that most of the inconsistency lies with the typing of cores. In contrast to Table 5.18, Table 5.26 shows that for the experienced analysts typing of flakes is fairly consistent, but uniface and biface inconsistency is relatively higher. This variability is almost solely due to the inconsistent typing of cores, unifaces, and bifaces among the principal coders. Thus, Coder 1 codes more cores, slightly more angular debris, and fewer flakes and unifaces than the other coders. Coder 5 codes low amounts of cores and angular debris and higher amounts of flakes and unifaces. Coder 8 trends between Coder 1 and Coder 5 for cores, angular debris, flakes, and unifaces, but codes more bifaces than either of the others.

Table 5-27 allows further examination of these differences focusing on the interpretation by individual analysts of the definition of cores versus unifaces versus bifaces. What Coder 1 codes as a core is sometimes coded as a core by Coder 5 and Coder 8, and sometimes as a uniface. What Coder 1 codes as either unifaces or bifaces are usually also coded as unifaces or bifaces, respectively, by the other coders. Considering the distribution of codes with respect to Coder 5's analysis of the item in question, we see that Coder 8 codes most of Coder 5's unifaces as unifaces, but also codes many of them as utilized flake/debris. This same trend is more apparent when comparing Coder 1's interpretations to Coder 5's codes and Coder 1 also codes as cores many of Coder 5's unifaces. Finally, looking at the codes with respect to Coder 8's analysis, these same trends are seen again, with Coder 1 coding core and utilized flake/debris when Coder 8 codes uniface. When Coder 8 codes an item as a biface, Coder 1 again codes cores, some unifaces, but mostly bifaces. Coder 5 codes the Coder 8 bifaces as unifaces and bifaces.

While it might be suspected that different material types will influence some of patterning in chipped stone type coding, no evidence could be found for this. That is, it seems quite feasible that items made from coarse-grained material, e.g., crystalline volcanic, will be

Table 5.26. Distribution of chipped stone codes among experienced coders within test assemblage. Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

	CHIPPED STONE TYPE								
CODER	Tst Cob/ Chunk	Core	Anglr Debris	Distl Flake	Pltfrm Flake	Uniface	Biface	Ground stone	TOTAL
EXPECTED	2.7	9.7	28.7	0.3	111.7	18.7	11.3	12.0	
1	5	19	37	0	102	10	7	15	195
	2.0	9.0	2.4	0.3	0.8	4.0	1.7	0.8	21.0
5	1	5	20	0	120	27	11	11	195
	1.0	2.3	2.6	0.3	0.6	3.7	0.0	0.1	10.6
8	2	5	29	1	113	19	16	10	195
	0.2	2.3	0.0	1.3	0.0	0.0	1.9	0.3	6.0
TOTAL	8	29	86	1	335	56	34	36	585
	3.2	13.6	5.0	1.9	1.4	7.7	3.6	1.2	37.6

more difficult to code with respect to chipped stone type than items made from fine-grained materials such as cherts and obsidians. Consequently, one might expect less agreement in chipped stone type codes for coarse-grained items than for fine-grained artifacts. Table 5.28 shows some evidence for this, but this particular state of the data could be due to chance as much as to the postulated influence of material type.

Another reason for the lack in consistency among experienced lithic analysts in distinguishing between cores, unifaces, and bifaces relates the working definition of each. Coder 1's emphasis on cores, Coder 5's emphasis on unifaces, and Coder 8's emphasis on bifaces are not necessarily contradictory since the morphological definitions of each are not mutually exclusive. As discussed in greater detail in Chapter 6, a core is a piece of material which exhibits no bulb of percussion and has three or more negative scars at least 2 centimeters long which originate from one or more surfaces. A uniface is defined as any artifact that has flake scars which extend over one-third or more of only one surface of the artifact. A biface is an artifact with flake scars extending over one-third or more of both the ventral and dorsal surfaces of the artifact. In terms of these definitions, then, unifaces and bifaces are specialized subsets of cores. A core, of course, may perform many of the tool functions of a uniface or biface and unifaces and bifaces are often used as cores.

The test assemblage contains only one artifact which one experienced analyst, Coder 5, recognized as a uniface 3 and no artifacts were typed as biface 3. Thus, it is not possible to assess, using the test assemblage, the ability of analysts to distinguish between functional cores, i.e., those artifacts typed as core, uniface 0-2, and biface 0-2, on one hand, and heavily modified items like uniface 3 and biface 3 on the other. The NHLEP chipped stone data base likewise contains few examples of artifacts typed as uniface 3 or biface 3, but, as Table 5.29 shows, the same trends discussed above for the tradeoff among cores, unifaces, and bifaces among the three experienced analysts is not evident. That is, in contrast to the results from the above

Table 5.27. Distribution of chipped stone type codes by coder. For example, of the 18 items coded as cores by Coder 1, Coder 5 called 27.7 percent of them cores, 16.7 percent of them utilized flakes/debris, 16.7 percent bifaces, and 11.1 percent other (groundstone or unutilized flakes/debris). UFD refers to Utilized/Retouched Flake/Debris, Unif to Uniface, and Bif to Biface.

		CODER 5					CODER 8				
CODER 1	**N**	**Core**	**UFD**	**Unif**	**Bif**	**Other**	**Core**	**UFD**	**Unif**	**Bif**	**Other**
Core	18	27.7	16.7	27.7	16.7	11.1	22.2	16.7	16.7	22.2	22.2
Uniface	10			80.0	20.0		10.0	10.0	60.0	20.0	
Biface	7			28.6	71.4					100.0	

		CODER 8					CODER 1				
CODER 5	**N**	**Core**	**UFD**	**Unif**	**Bif**	**Other**	**Core**	**UFD**	**Unif**	**Bif**	**Other**
Core	5	60.0			20.0	20.0	100.0				
Uniface	27	7.4	22.2	51.9	18.5		18.5	25.9	29.6	7.4	18.5
Biface	11				72.7	27.3	27.3		18.2	45.5	9.1

		CODER 1					CODER 5				
CODER 8	**N**	**Core**	**UFD**	**Unif**	**Bif**	**Other**	**Core**	**UFD**	**Unif**	**Bif**	**Other**
Core	5	80.0		20.0			60.0		40.0		
Uniface	17	17.6	29.4	35.3		17.6		11.8	82.4		5.9
Biface	16	25.0	6.3	12.5	43.8	12.5	6.3	6.3	31.3	50.0	6.3

analyses which show that Coder 1 has a tendency to overcode cores (as in single-platform core, multiple-platform core, bipolar core, blade core, etc.), in the NHLEP data base, Coder 1 codes somewhat fewer than expected functional cores, where a functional core in this case refers to all artifacts typed as core, uniface 0-2, or biface 0-2. Coder 1 also records the most biface 3s. In the NHLEP chipped stone assemblage, Coder 5 codes functional cores, uniface 3s, and bifaces 3s as expected, and no evidence for the above discussed tendency to overcode unifaces is found. Coder 8 appears to slightly overcode functional cores and undercode biface 3s. This tendency is in the opposite direction of that observed above for the test assemblage in which Coder 8 appeared to overcode bifaces. The frequencies of items discussed here, especially uniface 3s and bifaces 3s, may seem incredibly low, but represent the number of artifacts typed by these three analysts out of more than 7,000 pieces of chipped stone. In light of these results, our analysis of the chipped stone assemblage does not compare and contrast frequencies of artifacts typed as cores or unifaces or bifaces, but rather collapsed these types into analytic categories discussed here, i.e., functional cores versus uniface 3s versus biface 3s.

As given in Table 5.23, there are significant amounts of variability in coding of flake completeness even for experienced coders. This variability is presented in Table 5.30 and, in general, the coders seem to show similar total amounts of coding variability with respect to flake completeness. However, Coder 1 codes more items less than 50 percent complete and Coder 5 codes relatively fewer of these but more whole flakes. Coder 8 codes more items as being between 50 percent and 100 percent complete.

Other chipped stone attributes relate to flake genesis and morphology. Table 5.31 considers platform codes for each analyst showing a distinct lack of agreement. Coder 1 codes more multi-faceted platforms, Coder 5 codes more single-facet platforms, and Coder 8 codes more crushed platforms. Coder 1 codes twice as many (6) items with platforms coded "Other" than either Coder 8 and Coder 5, who code only 3 each.

Table 5.32 explores these tendencies further showing that platforms that Coder 1 coded as being multiple-faceted are called single-facet by Coder 5, and by Coder 8, both single-facet and crushed. Of those artifacts coded as having a single-facet platform by Coder 5, Coder 8 codes the platform as single-facet the majority of the time, but also codes many of them as having crushed platforms. Likewise, Coder 1 codes many of these as having single-facet platforms but also codes many of them with multiple-faceted and other types of platforms. Considering those artifacts with platforms that Coder 8 called crushed, Coder 1 codes them as having anything but crushed platforms, while Simons codes them as having mostly single-facet platforms.

Again, these coding discrepancies do not seem to be related to material type and the possible differential difficulty of consistently recognizing platform characteristics on coarse- versus fine-grained materials. Table 5.33 shows that the number of disagreements among the principal analysts is not higher for coarse-grained material types, compared with fine-grained material types.

Finally, Table 5.34 considers amount of cortex on the item as coded by each individual. As presented in Table 5.23, there is no significant difference in how the experienced coders record cortex. Coder 1 codes the fewest number of items with cortex absent and the most number of items with cortex between 50 percent and 100 percent. Conversely, Coder 8 codes the most items missing cortex, and the fewest items with greater than 50 percent cortex. Coder 5 codes the most number of items with between 0 percent and 50 percent cortex and codes only one item with an indeterminate amount of cortex (Coder 8 and Coder 1 each code seven), but otherwise trends between Coder 1 and Coder 8.

Table 5.35 examines coder consistency in coding presence/absence and kind of edge modification. In general, the experienced coders agree closely on the amount of edge modification due to either utilization or modification within the test assemblage. There is a some variability, however, in coding the type of modification. Coder 8, for example, sees more modification (modification extending from 2 millimeters in from the edge to 1/3 the tool surface) than utilization (modification within 2 millimeters of the edge). Coder 1 and Coder 5 see approximately

Table 5.28. Number of chipped stone types coded by experienced analysts, for those test artifacts coded as a core, uniface, or biface by one of the three coders, considered by material type.

Number of Chipped Stone Types Coded (of 3)	Material Fine-Grained	Type Coarse-Grained
1	14	1
2	16	5
3	9	5
Total	39	11

NOTES: Kolmogorov-Smirnov D statistic: 0.268
Chi-square statistic (for one-tailed Kolmogorov-Smirnov test): 2.465
At alpha=0.10 (2 degrees freedom), the critical value of the chi-square statistic is 4.605, which is not exceeded by the observed chi-square value. Therefore, there is no statistically significant difference in chipped stone type agreement between fine- and coarse-grained material types.

Table 5.29. Distribution of functional core (core, uniface 0-2, and biface 0-2), uniface 3 and biface 3 types among experienced coders within NHLEP chipped stone data base.

	CHIPPED	STONE	TYPE	
CODER	Functional Core	Uniface 3	Biface 3	TOTAL
1	155	1	8	164
	158.7	0.8	4.6	
	0.1	0.1	2.6	
5	121	0	4	125
	120.9	0.6	3.5	
	0.0	0.6	0.1	
8	141	1	0	142
	137.4	0.7	4.0	
	0.1	0.2	4.0	
TOTAL	417	2	12	431

NOTE: First entry is observed frequency, second is expected frequency, given row and column sums, and third is the cell Chi-square which measures the deviation between expected an observed.

Table 5.30. Distribution of flake completeness codes among experienced coders within test assemblage.

	FLAKE	COMPLETENESS				
CODER	50%	50%	100%	N/A	Indetrm	TOTAL
EXPECTED	10.0	17.3	133.0	13.7	22.0	
1	18	12	126	12	28	196
	6.4	1.6	0.4	0.2	1.6	10.2
5	5	14	147	8	22	196
	2.5	0.6	1.5	2.3	0.0	6.7
8	7	26	126	21	16	196
	0.9	4.3	0.4	3.9	1.6	11.1
TOTAL	30	52	399	41	66	588
	9.8	6.5	2.3	6.4	3.2	28.2

NOTE: Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

Table 5.31. Distribution of flake platform codes among experienced coders within test assemblage.

PLATFORM

				Single				
Multiple CODER	Missing	Cortical	Ground	Facet	Faceted	Other	Indetrm	TOTAL
EXPECTED	4.0	33.7	6.0	39.7	8.3	4.0	0.3	
Camilli	6	35	3	30	16	6	0	96
	1.0	0.1	1.5	2.4	7.1	1.0	0.3	13.4
Simons	1	35	2	48	6	3	1	96
	2.3	0.1	2.7	1.8	0.7	0.3	1.3	9.2
Larralde	5	31	13	41	3	3	0	96
	0.3	0.2	8.2	0.0	3.4	0.3	0.3	12.7
TOTAL	12	101	18	119	25	12	1	288
	3.6	0.4	12.4	4.2	11.2	1.6	1.9	35.3

NOTE: Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

Table 5.32. Distribution of platform codes by coder.

		CODER 5				CODER 8			
CODER 1	N	Crshd	Sngl-Fac	Mltp-Fac	Oth	Crshd	Sngl-Fac	Mltp-Fac	Oth
Crushed	2	50.0		50.0		100.0			
Sngl-Fac	20		80.0	10.0	10.0	10.0	75.0	5.0	10.0
Mtlp-Fac	14		57.1	28.6	14.3	21.4	42.9	14.3	21.4

		CODER 8				CODER 1			
CODER 5	N	Crshd	Sngl-Fac	Mltp-Fac	Oth	Crshd	Sngl-Fac	Mltp-Fac	Oth
Crushed	1	100.0				100.0			
Sngl-Fac	34	14.7	70.6		14.7		47.0	23.5	29.4
Mtlp-Fac	6	33.3		50.0	16.7	16.7	16.7	66.7	

		CODER 1				CODER 5			
CODER 8	N	Crshd	Sngl-Fac	Mltp-Fac	Oth	Crshd	Sngl-Fac	Mltp-Fac	Oth
Crushed	9	22.2	22.2	33.3	22.2	11.1	55.6	22.2	11.1
Sngl-Fac	30		53.3	20.0	26.7		76.7		23.3
Mtlp-Fac	3		33.3	66.6				100.0	

NOTE: For example, of the 20 items coded as having a single-facet platform by Coder 1, Coder 5 coded 80 percent of them also as having a singly-facet platform, 10 percent of them as having multiple-faceted platform, and 10 percent with some other type of plateform (cortical, missing, etc.). Crshd refers to crushed, Sngl-Fac refers to single-facet, Mltp-Fac refers to multiple-faceted, and Oth refers to other platforms.

Table 5.33. Number of platform codes recorded by experienced analysts, for those test artifacts for which a platform was coded, considered by material type.

Number of Chipped Stone Types Coded (of 3)	MATERIAL TYPE	
	Fine-Grained	Coarse-Grained
1	18	11
2	19	8
3	5	4
Total	42	23

NOTES: Kolmogorov-Smirnov D statistic: 0.155 Chi-square statistic (for one-tailed Kolmogorov-Smirnov test): 2.465

At alpha=0.10 (2 degrees freedom), the critical value of the chi-square statistic is 4.605, which is not exceeded by the observed chi-square value. Therefore, there is no statistically significant difference in platform code agreement between fine- and coarse-grained material types.

Table 5.34. Distribution of distal cortex codes among experienced coders within test assemblage.

	CORTEX					
CODER	None	<50%	>50%	100%	Indetrm	TOTAL
EXPECTED	90.0	71.3	18.0	3.7	5.0	
1	83 0.5	72 0.0	23 1.4	3 0.1	7 0.8	188 2.8
5	91 0.0	75 0.2	16 0.2	5 0.5	1 3.2	188 4.1
8	96 0.4	67 0.3	15 0.5	3 0.1	7 0.8	188 2.1
TOTAL	270 0.9	214 0.5	54 2.1	11 0.7	15 4.8	564 9.0

NOTE: Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

Table 5.35. Distribution of edge utilization/modification codes among experienced coders within test assemblage.

	UTILIZATION/MODIFICATION					
CODER	Absent	Present	TOTAL	Utilization	Modification	TOTAL
EXPECTED	111.0	21.0		4.7	6.3	
1	112 0.0	20 0.0	132 0.0	6 0.4	5 0.3	11 0.7
5	109 0.0	23 0.2	132 0.2	5 0.0	6 0.0	11 0.0
8	112 0.0	20 0.0	132 0.0	3 0.6	8 0.4	11 1.0
TOTAL	333 0.0	63 0.2	396 0.2	14 1.0	19 0.7	33 1.7

NOTE: Expected frequencies are given in first row. For each coder, first entry is the observed frequency and the second entry is the contribution of the cell to the overall Chi-square and represents the deviation of observed from expected. Row and column Chi-square sums are also given.

the same amount of both edge modification and utilization within the test assemblage.

In summary, the experienced analysts consistently code metric measurements like length, width, and thickness, make similar calls as to material type, dorsal cortex, and the presence/absence of edge modification. There is some variability in dorsal scar count, with Coder 5 coding more dorsal scars than Coder 1 and Coder 8.

Even among these experienced coders, however, there are large differences in chipped stone type and in type of platform, and some inconsistency in the coding of flake completeness. Since identification of chipped stone type is critical for determining what other sorts of attributes are then coded and since chipped stone type plays an important role in analysis of assemblages, coding inconsistency is a serious matter. Our chipped stone analyses have dealt with some of the inconsistency by collapsing chipped stone types into grosser types, like functional core, but this consistency analysis suggests that more work needs to be done on refining and restricting several of the type definitions. Similarly, since type of platform is a critical attribute for diagnosing the type of reduction technology, this inconsistency in coding platform among seasoned analysts who have trained together is somewhat alarming, but not unexpected. These results point to further needed development and refinement of the coding of platform.

After reviewing consistency results, Larralde (1984) concludes that is difficult to know just how serious these inconsistencies are. Some of the implications for these inconsistencies in terms of analysis and in terms of future in-field analysis of chipped stone are discussed below.

Inexperienced Analysts

This report now turns to analysis of the consistency with which less-experienced analysts, who were trained in chipped stone by the experienced analysts in extensive and repeated pre-field season sessions, recorded artifact attributes. Table 5.36 compares metric attributes like artifact length, width, thickness, and flake stage index. Again, only those artifacts for which the particular attribute was recorded by all analysts are considered in these analyses. Thus, the frequency of items considered here is less than the number of artifacts considered above for just the experienced analysts and the frequency varies depending on the attribute under consideration. Note that to reduce some of the confusion inherent to considering so many different coders all at one time, values for the experienced coders have been averaged.

As reported for the experienced coders, there is no significant difference in how length, width, and thickness is recorded among all analysts. The range in coder means for length is 27.9 - 29.4 millimeters (a difference of 1.5 millimeters), for width is 25.7 - 27.8 millimeters (a difference of 2.1 millimeters), for thickness is 6.9 - 7.9 millimeters (a difference of 1 millimeter), all of which are surprising consistent. Coder 9, however, consistently records slightly higher for artifact length, width, and thickness, and Coder 7 records lower for artifact width and thickness. When the flake reduction stage index is considered, there is some amount of significant variability. The average of the experienced coders appears to lie between the extremes of Coder 7, for whom stage indices are low, and Coder 9, for whom stage indices are high. At a significance level of 0.05, Coder 7 and Coder 9 are found to belong to different populations of the stage index, Coder 7 population A and Pike in population B.

Table 5.37 focuses on the coding consistency of dorsal scar count (DSC). To obtain the DSC value for experienced coders, only Coder 1 and Coder 8 were averaged, since Coder 5's mean DSC was significantly higher than either of theirs. Except for one inexperienced coder, there is no significant difference between how the experienced analysts and the inexperienced analysts coded dorsal scars. Of the inexperienced analysts, Coder 2 and Coder 3 recorded an average of between 0.5 and 0.7 fewer dorsal scars than the experienced coders. Coder 7 coded almost .3 more dorsal scars than the experienced coders and Coder 9 recorded an average of almost two less than that coded by the experienced analysts, which is statistically significant at the 0.05 level.

A flake with complete dorsal cortex and no flake scars, which is very thick, relative to its length, and which has a cortical platform would have a very low stage index, i.e., 0 (see Chapter

193

Table 5.36. Analysis of Variance and Tukey's studentized Range Test for continuous chipped stone variables for all coders with the mean of values for experienced coders.

	Length	Width	Thick	Stage
Experienced	27.896	27.004	7.582	4.721 AB
Coder 2	28.226	26.742	7.817	5.155 AB
Coder 3	27.817	26.301	7.677	4.359 AB
Coder 9	29.355	27.839	7.860	5.504 B
Coder 7	28.323	25.742	6.925	4.298 A
N	93	93	93	30
ANALYSIS OF VARIANCE				
F Value	0.27	0.56	0.82	2.98
Probability of larger F	.8966	.689	.510	.021
TUKEY'S STUDENTIZED RANGE TEST				
Critical Value at alpha=.05	3.873	3.873	3.873	3.907
Minimum Significant Difference	4.574	4.049	1.615	1.173

NOTES: The different letters A and B indicate the members of two different stage index populations (with most members belonging to both populations).

A indicates those stage means not significantly different at the alpha=.05 level.

B indicates those stage means not significantly different at the alpha=.05 level.

Table 5.37. Analysis of Variance and Tukey's Studentized Range Test comparing dorsal scar counts between the experienced coders and all other coders.

Experienced Coder DSC Mean Compared to	Lower Confidence Limit	Difference between Means	Upper Confidence Limit
Coder 2	-1.833	-0.671	0.489
Coder 3	-1.742	-0.576	0.591
Coder 9	-2.836	-1.670	-0.503 *
Coder 7	-0.874	0.292	1.459
N	53		
ANALYSIS OF VARIANCE			
F Value	6.32		
Probability of larger F	.0001		
TUKEY'S STUDENTIZED RANGE TEST			
Critical Value	4.779		

NOTES: *at alpha=.05, significantly different

The dorsal scar count for the experienced coder is the mean of Coder 1's and Coder 8's values.

6). In contrast, a flake with nine dorsal scars and no cortex which is very thin relative to its length, and which has a multiple-faceted platform, would have a very high stage index (10). The fact that Coder 9 recorded fewer dorsal scars than everyone else should contribute to a deflated dorsal scar count density (dorsal scar count divided by flake length) and hence a deflated stage index. Yet, as shown in Table 5.36, Coder 9's stage index mean was the highest of all analysts. This high mean stage value results from the fact that Coder 9 also measured high for length (although not significantly higher), leading to higher values of flake thinness (and a higher stage index). Coder 9 also coded more flakes with cortex absent which has consequences for a higher stage index value. The net effect of Coder 9's coding tendencies which result in coding thinner flakes with less cortex, and in spite of lower dorsal scar density, appears to be a higher stage index.

The following tables consider the distribution of codes among inexperienced analysts for non-metric variables. Again, to minimize confusion, only the experienced analysts having the least amount of total variation with respect to a given variable (as given in previous tables) is shown here and the designated experienced analyst is indicated in each table. These tables show that all analysts show remarkable agreement for gross material type (Table 5.38) with crystalline volcanics and indeterminate being the most problematic material types. Whereas the experienced coders seem to have problems in consistently identifying quartzite (and this same problem was evident in the NHLEP chipped stone data base [see Table 5.17]), there is less variability in coding quartzites and somewhat more in how cryptocrystallines, i.e., cherts, are coded. Coder 7 appears to undercode crystalline volcanics and overcode cherts, while Coder 2 overcodes crystalline volcanics. Coder 3 seems to be more prone to coding material type as "Indeterminate" or "Other" than other analysts, experienced or inexperienced.

Since the experienced coders showed some inconsistency in typing artifacts, it is not surprising to see similar amounts of inconsistency in how inexperienced analysts type artifacts. However, as Table 5.39 shows, the distribution of this typing inconsistency among inexperienced coders is very different from that seen for experienced analysts (Table 5.26). Type codes showing the most inconsistency for experienced coders were the types core, uniface, and angular debris (in order of decreasing inconsistency). For inexperienced analysts, angular debris is most inconsistently coded, then platform-bearing flakes, and then the type indeterminate.

The high amount of variability in coding angular debris is due to both Coder 3, who appears to overcode this, and Coder 7, who undercodes it. In conjunction with this, Coder 3 undercodes platform-bearing flakes, and Coder 7 overcodes them. Coder 3 is primarily responsible for the inconsistency in typing artifacts as indeterminate; whereas no one else typed the 191 artifacts in question as type indeterminate, Coder 3 coded two artifacts in this manner.

Typing an artifact as angular debris versus flake depends upon recognizing the presence or absence of flake characteristics such as platform and bulb of percussion, and being able to distinguish a ventral and dorsal side. Material type may play a role in this determination since fine-grained materials may more readily manifest flake characteristics than coarse-grained materials. In the test assemblage, however, no evidence could be found for fine-grained materials (as defined by the consensus material type of the experienced coders) being typed more or less consistently by inexperienced coders. That is, if all inexperienced coders recorded an artifact as a flake, it was just as likely that this artifact was made of obsidian as some other crystalline volcanic material. At the same time, an artifact for which there was dissent among the inexperienced analysts as to whether the item should be typed as angular debris or as a flake could be either coarse- or fine-grained.

For experienced analysts, the coding of flake completeness showed a significant amount of variability (see Table 5.40). This inconsistency is true also of inexperienced coders. Except for Coder 7, the inexperienced coders see fewer complete flakes than the experienced analyst (Coder 5) and code more flakes as having indeterminate completeness. Coder 3 undercodes complete flakes and codes 70 of the 178 artifacts as having indeterminate completeness; Coder 7 overcodes the number of whole flakes.

Table 5.38. Distribution of gross material type codes among inexperienced (in comparison with experienced analyst) within test assemblage.

	GROSS MATERIAL TYPE						
CODER	Glass Volcn	Crystl Volcn	Crypto Crystl	Quartzite	Sand stone	Indetrm Other	TOTAL
EXPECTED	31.2	39.8	98.2	11.4	2.8	7.6	
Experienced	31	36	103	14	3	4	191
(Coder 1)	0.0	0.4	0.2	0.6	0.0	1.7	2.9
Coder 3	31	36	100	10	3	11	191
	0.0	0.4	0.0	0.2	0.0	1.5	2.1
Coder 9	31	50	88	11	2	9	191
	0.0	2.6	1.1	0.0	0.2	0.3	4.2
Coder 2	32	48	90	9	3	9	191
	0.0	1.7	0.7	0.5	0.0	0.3	3.2
Coder 7	31	29	110	13	3	5	191
	0.0	2.9	1.4	0.2	0.0	0.9	5.4
TOTAL	156	199	491	57	14	38	955
	0.0	8.0	3.4	1.5	0.2	4.7	17.8

NOTE: First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

Table 5.39. Distribution of chipped stone type codes among inexperienced (in comparison with experienced analyst) within test assemblage. First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

	CHIPPED STONE TYPE									
CODER	Tst Cob/ Chunk	Core	Anglr Debris	Distl Flake	Pltfrm Flake	Uniface	Biface	Indetrm Other	Ground stone	TOTAL
EXPECTED	6.4	6.8	41.6	0.2	105.8	15.8	9.4	0.4	4.6	
Experienced	5	6	30	1	116	17	12	0	4	191
(Coder 8)	0.3	0.1	3.2	3.2	1.0	0.1	0.7	0.4	0.1	
Coder 3	8	2	70	0	82	13	8	2	6	191
	0.4	3.4	19.4	0.2	5.4	0.5	0.2	6.4	0.4	
Coder 9	8	12	40	0	105	13	7	0	6	191
	0.4	4.0	0.1	0.2	0.0	0.5	0.6	0.4	0.4	
Coder 2	5	8	47	0	103	14	11	0	3	191
	0.3	0.2	0.7	0.2	0.1	0.2	0.3	0.4	0.6	
Coder 7	6	6	21	0	123	22	9	0	4	191
	0.0	0.1	10.2	0.2		2.4	0.0	0.4	0.1	
TOTAL	32	34	208	1		79	47	2	23	955
	1.4	7.8	33.6	4.0	9.3	3.7	1.8	8.0	1.6	71.2

Table 5.40. Distribution of flake completeness codes among inexperienced (in comparison with experienced analyst) within test assemblage.

	FLAKE COMPLETENESS					
CODER	<50%	>50%	100%	N/A	Indetrm	TOTAL
EXPECTED	1.8	10.0	122.0	6.2	38.0	
Experienced	2	14	137	8	17	178
(Coder 5)	0.0	1.6	1.8	0.5	11.6	15.5
Coder 3	2	14	86	6	70	178
	0.0	1.6	10.6	0.0	26.9	39.1
Coder 9	0	11	114	10	43	178
	1.8	0.1	0.5	2.3	0.7	5.4
Coder 2	3	5	117	7	46	178
	0.8	2.5	0.2	0.1	1.7	5.3
Coder 7	2	6	156	0	14	178
	0.0	1.6	9.5	6.2	15.2	32.5
TOTAL	9	50	610	31	190	890
	2.6	7.4	22.6	9.1	56.1	97.8

NOTE: First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

Table 5.41 considers the distribution of platform codes among the inexperienced analysts. Platform codes of missing, other, and single-facet show the least amount of variability. Codes of indeterminate platform, cortical platform, ground platform, and multiple-faceted platform show the most amount of variability. Again, Coder 3 codes more platforms as indeterminate. Coder 7 sees more cortical platforms.

Experienced analysts showed little intercoder variability in identification of dorsal cortex. The inexperienced coders, however, as seen in Table 5.42, show somewhat more inconsistency principally in distinguishing between 50 percent and >50 percent cortex. The categories of cortex absent and 100 percent cortex show comparatively little variability.

Table 5.43 presents trends in the recognition of edge modification in the test assemblage by inexperienced analysts. As already mentioned above, experienced analysts report more evidence of utilization/modification than do inexperienced analysts. In the case of the test assemblage, the inexperienced coders identified half as many pieces of chipped stone debitage as showing evidence of edge damage due either to utilization or modification. In fact, some inexperienced analysts recorded less than a third of the artifacts that the experienced analyst (Coder 8) had identified as utilized/modified. In terms of the kind or extent of edge damage, there are only three artifacts in the test assemblage which were simultaneously coded by all inexperienced analysts as having some sort of edge damage.

In perusing these tables, it can be noted that there are some distinct trends in how individual analysts code artifacts. For example, Coder 3 codes the most amount of angular debris at the apparent expense of coding platform-bearing flakes (Table 5.39). Similarly, Coder 3 codes the most indeterminate artifact completeness (Table 5.40) and the highest frequency of indeterminate platform (Table 5.41). Coder 7, on the other hand, codes the lowest amount of angular debris and one of the higher amounts of platform-bearing flakes (Table 5.39). Coder 7 also codes the highest frequency of complete flakes (Table 5.40). The contrast between how these two analysts have coded artifacts may be an artifact of their familiarity with chipped stone knapping techniques, or, alternatively may be related to as mundane a factor as eyesight.

Table 5.44 considers how all analysts, experienced and inexperienced, coded the presence/absence of fire-alteration of an artifact. Experienced analysts, when compared to inexperienced analysts, coded a smaller frequency of artifacts as having been fire-altered. Note that the difference in how Coder 5 reports percent fire-alteration in the experienced group versus the inexperienced group is due to the smaller frequency of items considered for the inexperienced coders.

Descriptive Precision: Implications and Conclusions

In commentary on the results of a similar consistency test for the chipped stone analysts of the Seedskadee Project (1984), Larralde titled this section "Discussion: A Stand Against Throwing the Bath Water Out With the Baby." Rather than advocating the complete abandonment of all plans for analysis of the Seedskadee chipped stone data, collected under conditions similar to those obtaining on the NHLEP, Larralde suggested three courses of action.

First, Larralde suggested a more in depth analysis of coder idiosyncrasies to pin-down more completely coder deviations and inconsistencies. For example, does Coder 1 always code coarse-grained material items that are small and thin as angular debris, but items with a similar morphology, but more fine-grained material as platform-bearing flakes? If so, than all of the coarse-grained artifacts that Coder 1 recorded as angular debris can be decreed to be flakes. Similarly, if Coder 2 consistently records artifact length, width, and thickness at 2.1 millimeters less than everyone else, then every measurement made by Coder 2 can be adjusted accordingly.

A discussion of the morality of "editing" a data base in such a fashion has never been seen and it seems uncomfortable to deal with the idea of making such "corrections." This disquiet is especially great in the case of the first example, since it will never be the case that all angular debris were incorrectly recorded by Coder 1. By making a mass correction, new untruths would be introduced into the data base. Thus, the avenue taken here is let these trends in

Table 5.41. Distribution of flake platform codes among inexperienced (in comparison with experienced analyst) within test assemblage.

PLATFORM

CODER	Missing	Cortical	Ground	Single Facet	Multiple Faceted	Other	Indetrm	TOTAL
EXPECTED	1.4	23.8	3.0	31.2	8.0	0.2	2.4	
Experienced	0	23	1	39	6	1	0	70
(Coder 5)	1.4	0.0	1.3	2.0	0.5	3.2	2.4	10.8
Coder 3	2	27	1	27	3	0	10	70
	0.3	0.4	1.3	0.6	3.1	0.2	24.1	30.0
Coder 9	3	12	3	37	15	0	0	70
	1.8	5.9	0.0	1.1	6.1	0.2	2.4	17.5
Coder 2	1	16	9	31	11	0	2	70
	0.1	2.6	12.0	0.0	1.1	0.2	0.1	16.1
Coder 7	1	41	1	22	5	0	0	70
	0.1	12.4	1.3	2.7	1.1	0.2	2.4	20.2
TOTAL	7	119	15	156	40	1	12	350
	3.7	21.3	15.9	6.4	11.9	4.0	31.4	94.6

NOTE: First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

Table 5.42. Distribution of flake dorsal cortex codes among inexperienced (in comparison with experienced analyst) within test assemblage.

DORSAL CORTEX

CODER	None	<50%	>50%	100%	Indetrm	TOTAL
EXPECTED	93.8	55.8	15.0	4.4	6.0	
Experienced	95	57	13	3	7	175
(Coder 8)	0.0	0.0	0.3	0.4	0.2	8.9
Coder 3	81	73	13	4	4	175
	1.7	5.3	0.3	0.0	0.7	8.0
Coder 9	107	45	14	3	6	175
	1.9	2.1	0.1	0.4	0.0	4.5
Coder 2	100	52	11	4	8	175
	0.4	0.3	1.1	0.0	0.7	2.5
Coder 7	86	52	24	8	5	175
	0.6	0.3	5.4	2.9	0.2	9.4
TOTAL	469	279	75	22	30	875
	4.6	8.0	7.2	3.7	1.8	25.3

NOTE: First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

Table 5.43. Distribution of edge utilization/modification codes among inexperienced (in comparison with experienced analyst) within test assemblage.

UTILIZATION/MODIFICATION							
CODER	Absent	Present	TOTAL	CODER	Utilization	Modification	TOTAL
EXPECTED	118.2	9.8		EXPECTED	1.8	1.2	
Experienced	110	18	128	Experienced	1	2	3
(Coder 8)	0.6	6.9	7.5	(Coder 5)	0.4	0.5	
Coder 3	119	9	128	Coder 3	1	2	3
	0.0	0.1	0.1		0.4	0.5	
Coder 9	123	5	128	Coder 9	2	1	3
	0.2	2.4	2.6		0.0	0.0	
Coder 2	121	7	128	Coder 2	3	0	3
	0.1	0.8	0.9		0.8	1.2	
Coder 7	118	10	128	Coder 7	2	1	3
	0.0	0.0	0.0		0.0	0.0	
TOTAL	591	49	640	TOTAL	9	6	15
	0.9	10.2	11.1				

NOTE: First row is the expected frequency. For each analyst, first entry is the observed frequency and second entry is the contribution of the cell to the overall Chi-square and thus represents the deviation of observed from expected.

Table 5.44. Percent of artifacts coded as having fire-alteration by experienced and inexperienced analysts.

CODER	FIRE-ALTERATION
EXPERIENCED (N=200)	
Coder 1	3.5
Coder 5	2.0
Coder 8	2.0
INEXPERIENCED (N=190)	
Coder 2	2.6
Coder 3	3.6
Coder 9	4.7
Coder 7	4.7
Experienced (Coder 5)	2.1

NOTE: Frequency of artifacts in NHLEP test assemblage considered is given in parentheses.

individual coder idiosyncrasies guide our analysis. For example, since the three principal and most experienced analysts could not consistently distinguish between cores, uniface 0-2s, and biface 0-2s, this points towards analysis which lumps these three chipped stone types into functional cores.

In the second example, dealing with metric measurements, the risk of introducing further bias into the data base in the act of "correcting it" is reduced, since metric measurements are so very precise. However, in that the amount of error in the data base due to the analyst can be defined, this information can be used to help in interpreting patterns emerging from the analysis of chipped stone metric data. Since it hs been found here that the continuous variables show the least amount of overall inconsistency, and that for these variables only select individuals for select variables appear to code aberrantly, the avenue chosen is to use the consistency information to interpret significant differences in length, width, thickness, DSC, and stage index between assemblages.

The second suggestion made by Larralde (1984) concerns the redesign of the in-field analysis form, so as to eliminate the more inconsistently recorded attributes. This suggestion was employed in our design of the NHLEP chipped stone recording format by eliminating some of the egregiously inconsistent variables in the Seedskadee chipped stone data base, percent edge modification, and percent surface modification. One possible way around the core/uniface/biface inconsistency, which surfaced as an area of inconsistency in our analysis, may be a coding format which allows more objective specification of flake scar architecture. What is meant by specifying scar architecture is a series of variables which describe for each surface and for each of e.g., three possible directions, the number of flake scars greater than 2 millimeters. Unifaces might then be defined in a post hoc fashion as those artifacts for which only one surface was coded, and bifaces as those for which two surfaces were coded. Even with such a system, it is still quite possible that one coder would, given the same object, code only one surface, another analyst would code two surfaces, while still a third would code three or more and this would return us to the uniface/biface/core dilemma. Such a system, however, would allow us, in conjunction with artifact size, to get at core potential and may also provide a coding precision similar to that for flake dorsal scar count.

However, how one could design out the imprecision associated with the coding of angular debris versus flake, artifact completeness, and flake platform cannot be visualized. In the case of the first two problematic areas, it is suspected that further analyst education, especially in actual artifact knapping, might eliminate the inconsistency in coding of artifact completeness. That is, analysts familiar with the mechanics of chipping stone might be better able to recognize those critical criteria which makes a piece of debitage a flake rather than angular debris, and be better able to recognize when one is dealing with a complete flake versus one that is less than 50 percent. Such familiarity should also reduce the frequency with which the indeterminate code (be it for chipped stone type, platform, or flake completeness) is recorded. Thus, it would not be out of line to specify that encoding crew members on future projects of this sort have several seasons of detailed chipped stone analysis.

Since the primary chipped stone analysts have between them decades of analysis experience, it is unlikely that further training would contribute to greater consistency in recording flake platform or in resolving the apparent core/uniface/biface conflict. It is suggested that frequent, e.g., one per month, scheduled refresher courses in the coding of platform and other intractable variables would aid in maintaining inter-coder consistency.

Finally, Larralde (1984:5-6) suggests also that some determination of how consistent is consistent enough be made in light of the questions that could be asked of the archaeological record. This determination cannot be addressed here. Rather, the performance of the chipped stone recording format on a contemporary assemblage, for which size of raw material and type of reduction is specified, might be one way to make this determination (Larralde, personal communication 1986). In this fashion, one could assess the sensitivity of the recording format, which has been derived through inductive analysis of contemporary assemblages, to the behavioral aspects of the assemblage.

The results from this analysis of coder consistency have been used primarily to feed into the design of our analysis of the NHLEP chipped stone. Another role of such a test, however, would be that of identifying aberrant coding practices before going into the field. This would involve administering such a test just after training crew members in chipped stone analysis. The consistency results could then be used to identify aberrant coders, who might then continue with training or who might then be excluded from the encoding crew.

In the NHLEP chipped stone data base, some marked patterning has been identified in how individual chipped stone analysts code artifacts. Through controlled testing of the use of the chipped stone recording format by individual coders, it has been demonstrated that most of the patterning identified in Tables 5.17, 5.18, and 5.21 may be explained in terms of coder idiosyncrasies. Knowledge of these idiosyncrasies has allowed modification of the analyses so that the patterning chosen to investigate is that inherent to archaeological surface distributions and not that resulting from the biased recording of those assemblages.

CONCLUSIONS

Summary numbers cannot be given which say that the data base is 75 +- 10 percent correct; however the patterning in the data base which is felt might be an artifact of the discovery and chipped stone coding procedures can be discussed. It is emphasized that when the archaeological data base is coupled with calibration analyses of the sort presented here, the data base becomes immeasurably enriched. With analyses of this sort, not only can biases inherent in the data base be identified and controlled, but, equally important, is the objective feedback on the methods being used to create our document of the archaeological landscape.

Archaeological survey traditionally consists of walking a piece of land and marking on a map or aerial photo the locations of newly discovered sites. Rarely is any attempt made to evaluate discovery bias. Instead, it is assumed that all important sites or cultural manifestations have in fact been found and that they are recorded in a comparable fashion. With this data base of unknown veracity or consistency, archaeologists proceed to construct prehistoric settlement and subsistence systems.

The picture of the past that has been accumulating for North America over the past decades during which archaeological work has been conducted is, given our findings here, not so much a picture of the past as the picture of the melding of our survey biases and the character of surface cultural remains. Until archaeologists come to grips with the sterile reality of the archaeological data bases they have been assiduously compiling, and deal with such mundane tasks as obtaining an accurate and precise archaeological record, archaeology may remain a practice in which every new fact about the past can be challanged on the basis of poor data collection practices.

CHAPTER 6

LITHIC TOOL PRODUCTION, RECYCLING, AND USE

A total of 16,032 lithic artifacts and 19,105 pieces of fire-altered rock (FAR) were recorded by the Phase II survey. Chapter 6 describes the lithic artifact and FAR inventories and draws generalizations about technological strategies implemented on the West Mesa landscape with descriptions of chipped stone and groundstone assemblages from the intensively recorded survey units. These generalizations will be linked in Chapters 8 and 9 with models of location reuse proposed for the inner desert basin regions of south-central New Mexico.

MEASUREMENT AND CODING OF ARTIFACT ATTRIBUTES

Lithic artifact data were recorded on Fortran coding forms using an attribute coding scheme for chipped stone, groundstone, and FAR. The chipped stone and groundstone coding categories, definitions, and format were derived from a number of sources. These include Camilli's (1987) and Larralde's (1987) work in west-central New Mexico, distributional survey and lithic attribute coding by Wandsnider and Larralde (1986) in the Green River Basin in southwestern Wyoming and work by Camilli and Nelson (1983) in the Black Range of south-central New Mexico. The object of the recording format was to obtain information regarding flake reduction stage and artifact use, retouch or shaping, and breakage in addition to allowing the identification of artifact types.

Artifact definitions and forms were tested in the laboratory and under field conditions during these previously undertaken projects. In addition, surface collections made during reconnaissance of the Navajo-Hopi Land Exchange Project (NHLEP) area were used during a 1 week period of crew training which allowed for familiarization of crew personnel with definitions and for clarification of how to apply definitions. All information categories were designed for computer entry. The categories coded and their identifiers are listed below.

Record For All Lithics:

1-5 Shot Number: consisting of a flag color (orange or red), and an artifact number.

7-8 Material Type:
  1. obsidian
  2. other glassy volcanic
  3. basalt
  4. banded chert
  5. coarse-grained rhyolite
  6. fine-grained rhyolite
  7. vesicular basalt
  8. scoria
  9. indeterminate crystalline volcanic
  10. quartzite
  20. chert
  21. chalcedony
  22. petrified wood
  23. chalcedonic petrified wood
  29. indeterminate cryptocrystalline
  30. limestone
  39. indeterminate sedimentary
  40. sandstone
  41. quartzitic sandstone
  50. caliche
  80. other, specify
  99. indeterminate

11 Completeness: estimated completeness of artifact
  1. 1/2
  2. 1/2
  3. whole
  4. indeterminate distal flake fragment
  9. indeterminate

13 Fire-cracked rock tag: item has been altered by heat
  1. evidence of alteration

14 Size range for FAR, groundstone

fragments, tested cobbles, angular debris, distal flake fragments, and hammerstones

1. 3 - 6 centimeters maximum dimension
2. 6 - 10 centimeters maximum dimension
3. greater than 10 centimeters maximum dimension
4. 0 - 3 centimeters maximum dimension for other than

16-18 Length: maximum dimension (for flakes, maximum length of axis perpendicular platform) measured to nearest millimeter

21-23 Width: largest dimension perpendicular to the width measurement, to the nearest 5 millimeters

26-28 Thickness: maximum thickness, measured to nearest 5 millimeters

31-32 Type:

1. Chunk - a surficially unmodified cobble or piece of lithic material

2. Tested cobble -- cobbles from which a single flake or multiple flakes have been removed as if the material had been tested for suitability as a tool medium, and cobbles which appear to have been intentionally broken in half.

10. Core -- artifacts bearing no positive bulb of percussion, and which bear at least two or more negative scars which originate from one or more surfaces.

11. Multiplatform core -- a core with flakes removed from more than one platform plane

12. Single platform - a core with flakes removed from only one platform plane

13. Blade core - a core with blades (flakes more than twice as long as they are wide) removed from one platform plane

14. Bipolar Core - a core with platform remnants on opposing ends and with opposing negative scars or bulbs of percussion resulting from force rebounding from two directions

20. Angular debris -- debitage upon which no ventral surface can be defined but which does exhibit unquestionable negative scars characteristic of the percussion technique

30. Flake -- a lithic artifact which exhibits a dorsal and ventral side. Whole flakes exhibit a recognizable bulb of force and a platform

31. Biface thinning flake -- a long, thin curved flake with numerous dorsal scars, ventral lipping, a multifaceted platform resulting from removal from a worked edge, and no cortex

32. Pressure flake -- a flake resulting from final biface thinning, similar to a biface thinning flake but generally less then 1 centimeter in length and 1 millimeter in thickness

33. Bipolar flake -- defined by the presence of two positive bulbs of percussion on the same or different surfaces, or the existence of one positive bulb of percussion at one end of the artifact and a negative scar originating from the opposite end of the same or a different surface. Crushing at opposite ends of the item is often evident. Flakes often exhibit a conical bulb of percussion. A lateral strip of cortex often separates opposing platforms, thus differentiating bipolar flakes from bipolar cores.

40. Uniface -- any artifact that has flake scars which extend over one-third or more of only one surface of the artifact

41. Uniface 1 - a uniface exhibiting primary thinning (a unifacially worked edge, irregular outline, widely and variably spaced flake scars)

42. Uniface 2 - a uniface exhibiting secondary trimming (a unifacially worked, semi-irregular outline, and closely space or semi-regularly spaced flake scars)

43. Uniface 3 - a shaped piece, unifacially worked, with a regular outline and closely or quite regularly spaced flake scars

50. Biface -- any artifact which has flake scars extending over one-third or more of both the dorsal and ventral sides of the artifact. Bifaces undergo changes in morphology from the bifacial core or roughout stage, through the preform stage to a finished tool (after Callahan 1979; Camilli and Nelson 1983):

41. Biface 1 -- a biface exhibiting primary thinning (a bifacially worked edge, irregular outline, widely and variably spaced flake scars)

42. Biface 2 -- a biface exhibiting secondary trimming (a bifacially worked, semi-irregular outline, and closely space or semi-regularly spaced flake scars)

43. Biface 3 -- a shaped piece, bifacially worked, with a regular outline and closely or quite regularly spaced flake scars

60. Projectile Point -- a symmetrical, bifacially flaked implement with basal modification to enable hafting

80. Other

99. Indeterminate

34 Cortical covering
0. none
1. $<$ 50 percent
2. $>$ 50 percent
3. total
9. indeterminate

35 Dorsal scar count: 0-9, with more than 9 coded as
9. indeterminate

36 Platform characteristics
0. missing
1. cortical (cortex present on platform)
2. crushed
3. non-cortical single facet
4. non-cortical multiple facet
8. other, specify
9. indeterminate

Record for Tools:

38 Number of modified edges: 1 - 8, 9= entire edges or 9+ edges

39-40 Edge Modification: choose two most prominent
1. unifacial utilization (systematic scarring up to 2 millimeters from tool edge)
2. bifacial utilization (systematic scarring up to 2 millimeters from tool edge)
3. unifacial marginal retouch ($<$1/3 of surface)
4. bifacial marginal retouch ($>$1/3 of surface)
5. ground edge
6. battered/crushed/polished edge
7. retouched projections, notches, denticulated edges or spurs (note which in form margin)

Record for Projectile Points Only:

42-43 Breakage: refers to portion present -- choose up to 2
0. whole
1. tip
2. base
3. midsection
4. whole, tip crushed/battered
5. whole, tip broken
6. whole, base broken
7. reworked
9. broken, indeterminate fragment

Record for Groundstone:

51-52 Type:
10 Metate -- oval or rectangular stone slabs having a flat to concave grinding surface which are sometimes intentionally shaped by flaking, grinding, or pecking
11 slab
12 basin
13 bedrock
14 trough
18 other

20 Worked slab -- a thin, flat block of material intentionally shaped but with no apparent milling surface

30 Mano -- an artifact with at least one surface characterized by one or more smooth facets produced through grinding

31 ovate handstone (whole, 15 centimeter length or less)

32 subrectangular handstone

33 two hand (whole, >15 centimeter length)

34 mano/grinding slab

35 other

40 Hammerstone -- artifacts exhibiting battering with accompanying scars on surface edge margins (the intersections of two plane surfaces) or on convex surfaces; may not be prepared by unifacial or bifacial reduction

41 sphere
42 disk
43 oblong
44 irregular
45 pyramidal
46 other

80 Other, specify
99 Indeterminate fragment

54-55 Preparation:
  0. none
  1. pecked
  2. edges flaked/pecked
  3. grooved
  4. other,specify
  9. indeterminate

Code up to 3 surfaces for cross-section and wear:

Surface 1 - Columns 57-59
Surface 2 - Columns 61-63
Surface 3 - Columns 65-67

57 Worn surfaces
61 1. face
65 2. edge margin
4. other, specify
9. indeterminate

58 Cross section of utilized face
62 1. flat
66 2. convex
3. concave
4. irregular
5. other, specify
9. indeterminate

59 Wear
63 1. ground
67 2. battered
3. polished
4. crushed
5. striations present
6. pecked and ground
8. other, specify
9. indeterminate

80 Collection Tag -- all obsidian, bifaces, unifaces, projectile points and complete groundstone are collected
1. Item collected

The attribute coding scheme for chipped stone and groundstone was designed to facilitate the collection of data relevant to staged lithic manufacture, raw material utilization, tool functions, and tool-using strategies. Using the lithic data collected during this survey, Chapters 8 and 9 will examine assemblage content in order to identify different systemic strategies and their components in the Mesilla Bolson. The complex spatial information available through distributional archaeological survey will be exploited to examine differences in assemblage composition and to assess the contribution of various portions of the overlapping archaeological record to the overall patterning seen in the survey data.

CHIPPED STONE AND GROUNDSTONE ASSEMBLAGES

The chipped stone comprises approximately one third, the groundstone 8 percent, and the FAR almost half of all recorded material. The types of lithic artifacts in survey unit assemblages and their attributes are summarized and described in the following sections. Tables 6.1 and 6.2 list chipped stone and groundstone tool types recorded in each of the intensively surveyed Phase II sample units. Flakes and angular debris comprise the majority of chipped stone material recorded, while approximately 6 percent of all recorded chipped stone was classified as cores and facially modified tools.

Table 6.3 lists a summary of the artifact and feature data recorded during the distributional survey of sample units located on the West Mesa and in the adjacent Leeward Slope Zone of the lower Rio Grande Valley. (Appendix F contains

Table 6.1a. Chipped stone type frequencies in 400 X 400 meter survey units.

SURVEY UNIT	CHUNKS/ COBBLES	UNDIFF CORE	MPLT CORE	SPLT CORE	BIP CORE	ANGLR DEBRIS	FLK FRG	UNDIFF FLK	BFT FLK	PRES FLK	BIP FLK	UNIF 0,1,2	BIF 0,1,2	UNIF 3	BIF 3	PROJ PNT	OTHER	TOTALS
1	19		1	11		32	9	111		1	2		1			4	2	193
3	3		2			3	1	14										23
16			1															1
25	10	5		19	3	211	83	429	4	2	1	10	4			1	1	821
32	23	2		6		112	23	158			1	2	2			3		332
50	18	1	2	11		127	24	266	5	3	2	4	5		1	7		476
75	52		51	10	1	251	119	771	28	3	4	18	12		6	8	1	1,334
110	46	1	1	11	3	143	58	252	6		3	3	2		3	4		546

Table 6.1b. Chipped stone type frequencies in 800 X 800 meter survey units.

SURVEY UNIT	CHUNKS/ COBBLES	UNDIFF CORE	MPLT CORE	SPLT CORE	BIP CORE	ANGLR DEBRIS	FLK FRG	UNDIFF FLK	BFT FLK	PRES FLK	BIP FLK	UNIF 0,1,2	BIF 0,1,2	UNIF 3	BIF 3	PROJ PNT	OTHER	TOTALS
2	21	2	3	5		40	9	70	4		5	7	3		1	2		173
3	137	6	9	67	2	648	224	1,256	48	18	17	23	15		5	10	2	2,487
21	126	10	13	13	1	506	157	947	46	25	14	17	18		2	7		1,931
45	178	33	17	101	3	1,114	337	2167	66	25	18	47	29	4	3	12	2	4,156
48	38	1	1	19		143	29	226	1	1	1	9	3		1	1		474

Table 6.2a. Groundstone type frequencies in 400 X 400 meter survey units.

SURVEY UNIT	METATES	WORKED SLAB	MANO	MANO/ GRINDING	HAMMER STONE	INDETERM FRAG	OTHER	TOTALS
1	5	0	3	0	10	19	0	37
3	1	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	0
25	55	0	19	3	17	90	2	184
32	8	2	7	0	10	62	1	90
50	16	0	29	0	18	152	2	217
75	39	0	37	1	33	155	3	268
110	30	0	18	0	16	82	0	146

Table 6.2b. Groundstone type frequencies in 800 X 800 meter survey units.

SURVEY UNIT	METATES	WORKED SLAB	MANO	MANO/ GRINDING	HAMMER STONE	INDETERM FRAG	OTHER	TOTALS
2	21	0	10	1	5	9	2	48
3	148	8	99	5	72	297	3	637
21	125	1	64	13	50	125	3	381
45	208	1	130	8	65	498	2	912
48	39	0	42	7	27	86	2	203

TABLE 6.3.

WEST MESA ASSEMBLAGE SUMMARY.

```
UNIT ASSEMBLAGE SUMMARY                                                                         100--------------------
                                                                                 N     %     P     --------------------
AREA                              AREA (SQ. M.)   4492053     CHIPPED STONE  12940    32     E   80--------------------
                                                                FLKS/DEBRIS  12144    30     R     --------------------
UNIT ALL                          DENSITY        0.008983       CORES          479     1     C   60--------------------
                                                                TOOLS          317     1     E     --------------------
ASSEMBLAGE SIZE                   DPUA (X 1000)  0.000002                                    N   40--------------------
   TOTAL               40353                                                                 T     --------####--------
   FLAKE:TOOL RATIO    25.54                                  GROUNDSTONE     3092     8         20--------####--------
   FLAKE:CORE RATIO    16.90                                  FCR            19105    47           --##############----
                                                              CERAMICS        5216    13            1 2 3 4 5 6 7 8 9 1
                                                                                                       S T A G E      0
                                                              FEATURES         155                   (4693 FLAKES)

                               MATERIAL TYPE %       FLAKE TOOLS %   COMPLETENESS %        STAGE      LENGTH      THINNESS
FLAKES           COUNT   %  GVOL CVOL  CCS  QTZ   SS  UTIL RET ACC  <1/2 >1/2 WHL  IND    MEAN  STD   MEAN  STD   MEAN  STD URATIO
 TOTAL            7022 100     3   29   56    7    2     5   3   0     1   14  84    1     4.7 1.66   24.4 11.4    4.6 2.87   0.09

 UNDIFFERN        6668  95     3   30   55    8    2     5   3   0     1   14  84    1     4.6 1.62   24.8 11.4    4.5 2.78   0.09
 BIF THINNING      208   3     5    8   83    3    0     4   2   0     1   18  79    1     6.8 1.31   17.3 7.41    7.5 3.83   0.06
 PRESSURE           78   1     9   17   73    1    0     0   0   0     0    6  88    5     6.7 1.30    9.0 2.45    7.0 2.87   0.00
 BIPOLAR            68   1    44   16   32    4    1     3   4   0     0    7  85    7                25.3 12.5               0.08

 DIST FRAGS       1073         2   28   61    6    1     3   3   1

                               MATERIAL TYPE %        UTIL EDGES %                               SIZE %              CORTEX %
CORES            COUNT   %  GVOL CVOL  CCS  QTZ   SS  UTIL RET ACC                         0-3   3-6  6-10  10+     0 <1/2 >1/2
 TOTAL             479 100     8   23   62    3    1     5   5   0                          11    58    25    1    15   53   23

 UNDIFFERN          61  13    13   23   56    2    2    13   3   0                          16    61    20    0    13   49   25
 SINGLE PLATF       57  12     5   26   54   11    0     5  11   0                           7    54    28    4    12   44   33
 MULT PLATFRM      348  73     5   24   66    1    1     3   5   0                           8    59    26    1    17   57   20
 BIPOLAR            13   3    69    0   31    0    0     8   0   0                          69    31     0    0     0   23   54

 TST COBBLE        127        14   37   35    6    3     0   5   0                          19    47    27    4     1   14   75
 ANG DEBRIS       3922         2   35   39   10   10     2   3   0                          42    46     8    2    39   35   13

                               MATERIAL TYPE %                       COMPLETENESS %         PORTION %          LENGTH
FORMAL TOOLS     COUNT   %  GVOL CVOL  CCS  QZT   SS                <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND    MEAN   STD
 TOTAL             317 100    14   10   72    2    0                    16   14  62    8      2    8    9    0    38.1  16.2

 UNIFACE 1          89  28    11   16   71    0    0                     6    6  75   13      0    0    0    0    43.8  17.8
 UNIFACE 2          48  15     6   10   79    0    0                    13   19  60    8      0    0    0    0    40.4  14.8
 UNIFACE 3           4   1     0    0  100    0    0                    25    0  75    0      0    0    0    0    24.0  12.9
 BIFACE 1           66  21     9    5   77    6    0                    18    5  70    6      0    0    0    0    41.4  16.4
 BIFACE 2           29   9    17    7   72    3    0                    24   17  55    3      0    0    0    0    33.7  9.31
 BIFACE 3           22   7     9    9   77    5    0                    59   23   5   14      9    0    0    0    29.7  18.8
 PROJ PNT           59  19    32    8   58    0    0                    10   31  56    2      7   42   49    0    30.0  10.4

                               MATERIAL TYPE %        UTIL EDGES %                                 SIZE         CORES  FCR
GROUNDSTONE      COUNT   % CL-LM CVOL  CCS  QZT   SS  UTIL RET ACC                         0-3   3-6  6-10  10+     %    %
TOTAL             3092 100     3   26    4   29   37     0   1   0                          14    45    25    5     1   35

HAMMERSTONE        323  10     3   72   12   11    1     1   1   0                           2    37    46    3     9   14
MANO               458  15     3   17    3   10   66     0   0   0                           3    40    38    5     1   29
MANO-GRSLAB         38   1     0   11    0    5   84     0   0   0                           0    37    45   11     3   21
METATE             698  23     2   22    2   30   43     0   1   0                           8    41    34   12     0   34
UNID FRAG         1575  51     3   22    3   39   32     0   1   0                          23    50    12    2     0   42

FCR              19105        89    3    0    1    5                                         0    84    14    2

                 COUNT      DIVERSITY INDEX      BWL/JAR RATIO
 CERAMICS        5216            1.00                 0.3
```

Note: Measures of flake stage and thinness are described in the FLAKE STAGE section of this chapter. Flake Uratio is equivalent to utilized/unutilized items.

additional assemblage summaries of individual survey units.) This table compares lithic artifact material type and attribute data among types of tools and debris. A number of patterns evident in this table will be pursued below. These include (1) a predominance of cryptocrystalline materials in chipped stone assemblages particularly in flake assemblages produced during later stages of reduction sequence pointing to use of this general category of materials patterning in a regular way with provisioning strategy rather than cultural period, (2) reliance on bipolar reduction of local obsidian gravels as evidenced in the high proportion of glassy volcanics in the recognized bipolar flake assemblage, (3) prepared toolkits including cryptocrystalline carried and maintained unifacial and bifacial cores, and (4) the high proportion of fire-altered groundstone and FAR in material types other than caliche as evidence for intensive tool recycling.

Lithic Raw Material Resources

Lithic materials used most often for the manufacture of chipped stone and groundstone implements recorded by the Phase II survey have been identified in rock strata of the Franklin Mountains and in alluvial gravels on the western and eastern sides of the Franklins. The gravels of the Santa Fe Group constitute another major lithic source being composed of 10 percent chert and 8 percent quartzite pebbles (Ruhe 1967) along with other rounded gravels of non-local origin. These are present on Rio Grande terrace remnants located for the most part on the eastern side of the Rio Grande and are exposed on the ridges and slopes below the West Mesa escarpment on the western side of the valley. In addition, small knappable nodules of chert and obsidian of the Santa Fe Group are among the interdunal lag gravels on the West Mesa itself.

With the exception of the interdunal gravels, however, lithic raw materials are not immediately available on the West Mesa Surface. This means that most of the materials from which chipped stone and groundstone tools and debris were produced (certainly including those from which relatively large lithic items were produced), originated at locations outside of Phase II survey units on the West Mesa Surface. These places may have been as close as the western slopes of the Rio Grande Valley in the case of items produced from Santa Fe gravels, while alluvial gravels and rock outcrops in the Franklins provide another more distant source of materials.

Two problems confront identification of lithic material source locations for archaeological materials in the El Paso region. First, the Santa Fe gravels include cherts and other materials of non-local origin; as such these constitute a local source for "non-local" lithic materials as pointed out by Carmichael (1983:138). In the case of Franklin Mountain cherts, quartzites, rhyolites, limestone and obsidian, widespread alluvial gravels may be the more likely sources of these materials rather than actual outcropped strata. In addition, interbedded strata may be exposed in more than one location. Specific resource locations for these common materials may therefore be difficult, if not impossible, to identify.

For these reasons and because no lithic resource studies have systematically addressed the ranges of chert and other materials in local gravel deposits, a general overview of lithic material sources in the El Paso-West Mesa area will be offered. The geological literature pertaining to rocks of the Franklin Mountains and nearby West Mesa serves as the main source of information about local rock types. The recent archaeological literature includes several studies (Carmichael 1983; Warren 1987) of lithic material sources bordering the Tularosa Basin which provide additional information. Locally available lithic raw materials from the Franklin Mountains have recently been summarized by Hicks (1985).

Potential Lithic Material Sources -- General Overview

Cherts are found in several strata in the Franklin Mountains. A light gray chert occurs in lenses in the Precambrian Castner Limestone and lenses of a dark gray chert can be found in exposed parts of Middle Devonian strata. Thin beds and nodules of a nearly black cherty limestone occur in the Rancheria Formation (Laudon and Bowsher 1949:19) which outcrops in the northern Franklin Mountains, Hueco Mountains, Bishop's Cap, and Rattlesnake Ridge (Carmichael 1983:Figure 23). Rancheria chert is described as brown-weathering and porous ranging in color "from black to light brown with the entire range sometimes present in a single nodule" (Carmichael 1983:140) and, although not classified separately from other chert varieties by this project, it occurs commonly on the West Mesa as flakes, cores, and minimally modified nodules.

The Permian Hueco Limestone also contains massive beds of cherty, fossiliferous limestone. Chert occurs as abundant gray nodules and as fossil replacement in the Middle Unit of this last formation. Other nodular sources include the El Paso Limestone of Ordovician age and the Aleman member of the Montoya Dolomite; both also contain chert lenses. Veinlike networks of chert are contained in the Silurian Fussleman Dolomite. Basal levels of the Las Cruces Limestone in the Franklin Mountains are the location of layers of a black chert a few inches thick which are found near Anthony's Nose. Additionally, gravels of the Santa Fe Group exposed on the ridges and slopes of the western side of the Rio Grande Valley contain small chert nodules less than 8 centimeters in length and of varying quality (Bradley 1983:53).

Cherts form 54 percent of the chipped stone flake and 36 percent of the angular debris at the site of La Cabrana (Bradley 1983:64) on the western bank of the Rio Grande. O'Laughlin (1980:166) has analyzed rock type variations in color, texture, and inclusions for chipped stone artifacts from Keystone Dam Sites 33 and 34 and lists 22 chert varieties based on these criteria present in these assemblages. The seven more abundant varieties comprising 5 percent or more of samples were noted as being present in local Santa Fe gravels on the lower elevations of the west alluvial slope of the Franklin Mountains. O'Laughlin states that most other varieties were also noted in this area, although, since no systematic study of the materials present in local gravels was carried out, it could be that some chert types occurring at lower frequencies are not locally available.

A chert variety described by Warren (1986:Table 1) as "dark red to purple red; may grade to quartzitic siltstone, sandstone" with sources cited as "Abo Formation, Permian, and gravel, Bear Peak," may correspond to a distinctive banded chert (material type 4) common on the West Mesa and elsewhere in the El Paso area (Thomas O'Laughlin, personal communication). This chert type is very likely O'Laughlin's (1980:Table 16) chert variety Number 2 which makes up more than 5 percent of Mesilla Phase materials at Keystone Dam Site 34.

Rhyolites are the most abundant rock type in the area ranging from very fine- to coarse-grained types with numerous phenocrysts. Soledad Rhyolite which outcrops in the Organ Mountains (Dunham 1953; Ruhe 1967) occurs in local river gravels and is a fine-grained variety with good conchoidal fracturing properties (Bradley 1983:54; Carmichael 1983:165). Warren (1985:6) classifies Soledad Rhyolite with porcellanites or glassy rhyolites of the Organ and Dona Ana Mountains, described as silicified tuffs with "flinty, cryptocrystalline textures" which have a glassy matrix with occasional phenocrysts of quartz and feldspar. Some porcellanites have been identified in the uniface and biface collections from Phase II survey units.

Thunderbird Rhyolite outcrops in the southern Franklin Mountains and occurs as a major constituent of alluvial gravels in the form of 5 to 20 centimeter subangular cobbles (Bradley 1983:54-55). This variety of rhyolite is described as "a very coarse-grained porphyritic material with numerous angular, rose-colored phenocryst inclusions" (Bradley 1983:54) and probably corresponds to O'Laughlin's (1980:Table 16) rhyolite variety Number 1 which makes up about 19 percent of the chipped stone material in samples from Keystone Dam Sites 33 and 34. Rhyolites make up 8 and 9 percent, respectively of the angular and flake debris at La Cabrana. Both fine- and coarse-grained types are present in West Mesa lithic assemblages, with the very coarse-grained Thunderbird Rhyolite commonly used for hammerstones and occasionally for grinding implements.

Local sources for sandstone include the Bliss Sandstone Formation in the Franklin Mountains which contains a fine-grained red to brownish-red sandstone as well as other sandstone lenses found interbedded with other materials in Cretaceous strata. Bradley (1983:55) mentions fine-grained, friable and coarse-grained varieties which also occur in the Franklin Mountains. Fine-textured metamorphosed sandstone, siltstone, and shales occur in the Lanoria Quartzite Formation in the Franklin Mountains.

Quartzites common in the Tularosa Basin are light gray in color or a banded green and gray type abundant on the eastern side of the Franklin Mountains north of Transmountain Road (Carmichael 1983:139). This grayish-olive quartzite that may correspond to O'Laughlin's quartzite type Number 6 (1980:Table 16) is often present in West Mesa groundstone assemblages. Fine-grained varieties noted in Phase II survey units are light gray or pinkish beige in color, the latter with oxidized inclusions.

Basalts come from varied sources, but are not a common material type within the study area. Mundy Breccia boulders in the Franklin Mountains, the local river gravels, and basalt flows in the Mesilla Bolson on the western side of the Rio Grande may all be potential primary sources. On the West Mesa, the Santo Tomas and Black Mountain olivine basalt flows to the north, the Aden basalt field (Hoffer 1975), and basalts of the Potrillo Mountains to the northwest and west are potential basalt sources as well as locally including trachyte, latite and andesite and tuff. Carmichael (1983:142) suggests the Potrillo Mountains as a source for vesicular basalt. Basalt scoria cones at the north end of the Jarilla Mountains have been cited as one source location of this material (Warren 1985:Table 1).

Other volcanic rocks of the Franklin Mountains include an andesitic porphyry, Campus Andesite (Hoffer 1969), used for the manufacture of metates and other grinding tools. Andesite plutons of this material form a series of small hills in the city of El Paso at the southwestern tip of the Franklin Mountains as well as andesitic core of Sierra de Cristo Rey. Andesites were noted in the Phase II assemblage and Santa Teresa assemblages (Hicks 1985:Table 7.1). Welded tuffs which may come from several sources in the Organ Mountains (Carmichael 1983:142) are very rare. Metamorhpic materials are rare but do include a green chlorite schist mentioned as a relatively rare material in Tularosa Basin archaeological assemblages used for manufacturing pestles (Carmichael 1983:143). Several unmodified chunks of this material were recorded during the Phase II survey. Warren (1985:Table 1) also notes a piece of muscovite schist possibly originating from Precambrian rocks of Bear Peak or the San Andres Mountains used as a pestle in the Jarilla Mountain area.

Obsidian nodules less than 5 centimeters in maximum dimension occur in the axial gravels of the Rio Grande. These constituents of the interdunal lag gravels on the La Mesa Surface together with equally small coarse-grained chert nodules form the only source of immediately available raw material for chipped stone tool production on the West Mesa. Another potential lithic material source must be mentioned. Given the scarcity of immediately available raw material on the West Mesa Surface, previously deposited artifacts constitute a major "raw material" source which if regularly utilized would result in a high degree of tool recycling.

Models of Differential Raw Material Selection

The question of differential lithic raw material selection by Preceramic and Formative period groups in south-central New Mexico is addressed in this section of Chapter 6 with an examination of the material type composition of assemblages. Assumed differences in material type diversity and composition between Preceramic and later occupations have been used to suggest that tool production techniques, and therefore differences in the organization of technologies, differ between early and later occupations of the region (Carmichael 1983a:185; Thompson and Beckett 1979:71). In this and the next section, data will be presented which indicate similarities in material type proportions and in flake attributes among early and late occupations of the region and therefore potential similarities in the degree of technological planning undertaken.

The differential use of lithic raw materials through time in south-central New Mexico has been approached with several models which seek to explain varying proportions of siliceous cryptocrystallines and crystalline volcanic rocks in lithic assemblages assigned to sequential periods and phases. Explanations rely on variation through time in degree of mobility and in the preferential use of certain raw materials due to reliable fracturing properties.

The premise that immediately available materials form the bulk of the lithic inventory if a group is sedentary is basic to one model of differential raw material selection (Carmichael 1983a:285; Hard 1983:23). This model contends that in the context of high mobility, a greater variety and more nonlocal materials are used.

Differences in the diversity of lithic materials between Paleoindian and Archaic assemblages are attributed to "changing patterns in group mobility and tool curation" during the Archaic (Carmichael 1983a:188).

Differences in the use of cherts and rhyolites in the southern Tularosa Basin between the Paleoindian and Archaic period, and the Mesilla and El Paso Phases are explained by these factors. Cherts dominate in Archaic assemblages with cherts and rhyolite important in Mesilla Phase assemblages, while rhyolites are more prevalent in later Puebloan assemblages (Carmichael 1983a:Table 19; Whalen and Thompson 1979:20). Mesilla Phase assemblages in the Tularosa Basin are similar to Archaic assemblages in that both have higher lithic material type variety than later sites (Carmichael 1983b:185).

This similarity in material types between Archaic and Mesilla Phase assemblages has been attributed to the predominance of non-residential Mesilla Phase sites ("camps") in the Tularosa Basin which contain a variety of materials similar to Archaic sites there (Carmichael 1983a:187). Mesilla Phase residential chipped stone inventories are likened to those at later Puebloan sites. The chipped stone inventory of later ceramic "manifestations" include the presence of only one or two material types composed of large numbers of similar-sized flakes and expended cores (Carmichael 1983a:185). Thus, in comparison to Archaic and Mesilla Phase strategies of tool use which incorporate curated tools of a number of different materials into a mobile seasonal round, the chipped stone technology represented by El Paso Phase assemblages is seen as expedient with a change in "technology", or production technique, due to sedentary conditions accounting for less raw material variety in Puebloan assemblages.

In another model, the preference for chert as a manufacturing medium has been attributed to its more predictable fracturing properties and the fact that more durable, sharper edges can be produced with cherts than with other materials (Goodyear 1979:4-5; O'Laughlin 1980: 166). A greater percentage of chert items in Archaic period deposits at Keystone Dam was attributed to the preference for chert for manufacture of small tools which functioned in Archaic tool kits. A recent model of the seasonal round of Mesilla Phase groups suggests that at base camps near the mountains "whichever material is closer and denser, usually volcanic rock should be used (Hard 1983a:23)" -- an expectation for the use of local materials during seasonally sedentary periods. During mobile periods, chert is anticipated as the most frequently used raw material. Because of its fracturing properties, chert is expected to be selected over volcanic rock for long distance transport into desert basins and where it would be subject to a high degree of recycling.

To more fully understand differences, if any, and similarities between archaeological cultures in the region, a consideration of the complexities introduced into the archaeological record by widespread recycling of discarded lithic materials is necessary. The term recycling denotes a general process by which previously discarded materials are again appropriated for use. Materials retrieved from an archaeological context to function in a systemic context are said to have been scavenged (Schiffer 1976:34) rather than recycled wholly within systemic context. Viewing scavenging from another perspective, archaeological deposits can operate as repositories from which expediently useful materials can be retrieved (Deal 1985:271; Newell 1987:147) and, thus, essentially remain in systemic context. The term recycling will be used interchangeably with the term scavenging here to refer to reuse of discarded items, regardless of their context.

Scavenging has been observed as a common practice among a number of groups (Ascher 1968:50-51; Binford 1979:266; Janes 1983:26), and the recycling of discarded lithic materials has been recognized as widespread among the prehistoric inhabitants of different regions (Collins 1975:19; Gould et al. 1971:163). The recycling of lithic materials at revisited or long-term occupation sites has also been acknowledged as a determinant of assemblage content in some studies (Hofman and Morrow 1984:176-177; Simms 1983; Sullivan and Rozen 1985:773). However, recycling has yet to be considered as an important and ubiquitous process contributing to the formation of the archaeological record within a region (Wandsnider 1987). The next sections of this chapter examine correspondences between the material type composition of assemblages within one region in south-central New Mexico and models of raw material selection in light of pervasive recycling of discarded lithic artifacts.

Accommodating Tool Production to Patterns of Group Movement

A technological system relies on strategies for the procurement of raw materials and for the production, use, and recycling of tools which must be accommodated to group mobility patterns. This means that modeling technological options must consider the degree to which tool requirements are anticipated by the system whether or not it is a highly mobile one. Reduced mobility and curation of bifaces are the reasons offered as causes for lower lithic material type variety in Archaic assemblages compared to Paleoindian assemblages, and changes in production technique are cited for differences between Mesilla Phase and later Ceramic Period lithic assemblages in above models of differential raw material selection. However, patterns of group movement and technological investment in carried, maintained tools should not be ignored when interpreting the technologies of later more sedentary occupations of the region.

Some technological options for tool production in mobile systems rely on carried, prepared cores, preformed tools, or finished implements to meet "planned" tool requirements. In the context of anticipating tool requirements, raw material procurement is most likely "embedded" in other subsistence tasks (Binford 1983:273-275) carried out during a seasonal round in these systems. Raw material can be cached subsequent to its procurement or introduced into residential bases where core preparation and tool production occur during "down time" (Torrence 1983:12). Expedient production from immediately available local raw materials as well as gear recycling might furnish tools for "unplanned" tasks in the same system. Which particular production alternative is employed is dependent on the degree to which subsistence tasks are anticipated and contingency plans laid for other activities, the state of implements and cores in a personal tool kit, and in the case of expedient tool production the availability of raw materials.

Additionally, tasks which are anticipated might be undertaken with expediently produced tools if local materials are known in advance to be available--a kind of "planned expedience."

This model of tool production alternatives in mobile systems presupposes a settlement system of seasonal residential bases and other special activity areas. The organization of the labor force for activities carried out away from the residential base is logistical--skilled personnel carry out planned tasks which are partitioned between locations. Raw materials collected during the course of logistically organized activities enter into a tool life cycle beginning with the creation of cores and tools whose design enables continuous and reliable rejuvenation and reliable recycling into wholly new tools. The process of tool production, maintenance and redesign when organized logistically results in the occurrence of production debris from a single implement at widely distant locations, the implement itself, if not irreparably damaged in the field, may be returned to a residence or discarded at a point in its life cycle when its use is no longer anticipated.

Several factors must be taken into account in assessing a claim that expedient technologies are a characteristic of later ceramic period occupations. First, debris discarded in the highest proportions at relatively long-term occupations will tend to have the shortest use lives. The production and discard rates for items like flake tools coupled with long-term occupation of a place will ensure that they are more abundant in deposits than are tools subject to continual maintenance (commonly thought of as "curated tools") which are not discarded at the same rate (Cammerman and Feldman 1974:616). The higher visibility of long-term occupations and therefore their higher rate of discovery may result in the perception that expediently manufactured, short use life items are the most common and important items in the technology.

Another important consideration is that the planning element in a technology may not be recognized directly from tool form (Binford 1986:558-559). Sedentary systems should incorporate a logistical settlement component since resources not present within a day-use zone around the residence must be obtained elsewhere. When unmodified flakes meet tool requirements and local materials are not available such as in the inner desert basins, minimally altered core material could be imported into field locations. In this case, although a flake/core production technique is employed, the technology is not organized in an expedient manner, it is planned. Additionally, where archaeological deposits are known to occur in the vicinity of planned resource procurement tasks, scavenging of these deposits and tool recycling would incorporate an element of planned expedience into the technology. Thus, planned technologies can incorporate carried/maintained tools as well as those produced in a seemingly casual fashion. This last technological option would have been particularly important in desert basins lacking lithic raw materials where sedentary settlement systems may have been organized around systematic reuse of locales from a permanent residential base.

Material Type Composition of Mountain Periphery and Desert Basin Assemblages

The material type composition of assemblages in mountain periphery and basin floor settings in the vicinity of El Paso, Texas can be compared with Keystone Dam Site (Carmichael 1985; O'Laughlin 1980) and West Mesa lithic assemblages (Table 6.4). Viewing the grouped Keystone and the West Mesa assemblages as lithic debris which has accumulated over long time spans representing the composite debris from base camp and other occupations, a high incidence of chert use on the West Mesa is expectable given selection of chert for long distance transport and a higher potential recycling rate for chert artifacts in areas lacking raw material.

Table 6.4. Selected material type proportions in summed assemblages from the West Mesa and Keystone Dam areas.

	KEYSTONE DAM SITES: 33 AND 34	36 AND 37	WEST MESA ASSEMBLAGE
OBSIDIAN	0.9	2.6	2.72
CHERTS	50.2	45.2	51.25
DOLOMITE	13.8	13.9	2.19
RHYOLITE	19.2	14.7	18.87
QUARTZITE	13.5	5.7	7.57

Comparing Keystone sites and West Mesa assemblages, higher proportions of dolomite present in abundance on the western periphery of the Franklin Mountains are used there. However, cherts are listed as the dominant material type for cores, flakes, and utilized items at Keystone Dam sites on the western periphery of the Franklin Mountains rather than the locally more abundant dolomite or rhyolite--a pattern which could at least in part be attributed to the preferred fracturing properties of chert. Together dolomite and rhyolite are the most abundant raw materials in the local gravels in the Keystone Dam area and were used in higher proportions than on the West Mesa, while chert which is locally less abundant in the Keystone Dam area gravels and virtually absent on the West Mesa are used in very similar proportions.

These general findings suggest that chert is preferentially selected for the manufacture of a wide range of tool types especially those operating in mobile contexts. In the Keystone Dam case, chert tools may have been continually "cycled through" areas which are peripheral to mountains where other raw materials are abundant. This possibility presupposes the composite nature of assemblages in places such as mountain peripheries where "sites" are commonly located as well as in desert basins where the surface distributions of artifacts have been recognized as composites (Ravesloot 1985b:17).

Material Types in Period and Phase Categories

Material types in West Mesa lithic assemblages can be compared to those obtained with conventional site survey procedures in order to assess the presence and strength of patterns of lithic material type composition noted for Archaic, Mesilla, and El Paso Phase assemblages elsewhere in the region. To accomplish this comparison, point-plotted artifacts inventoried by the Phase II survey were grouped into spatial associations. Description of the techniques involved in reducing point-plotted surfaces to spatial aggregates is presented in Chapter 4.

Most spatial associations of artifacts and features on the West Mesa surface probably represent composites of debris from multiple activities and occupations, some widely separated in time; this assumption applies equally to the spatial associations or artifact clusters used in this analysis. Nonetheless, conventional survey techniques seek to define artifact concentrations as sites, many of which are directly attributed to past activities and groups. This analysis, therefore, seeks to identify such site assemblages. In comparison to the archaeological sites identified through conventional site survey procedures, the artifact clusters identified here are relatively small, about 50 square meters in size, containing an average of 20 artifacts. Clusters, thus, are small and relatively compact and constitute associations of surface artifacts which are more systematically defined than are field identified "sites".

In all, 1,796 artifact clusters were defined based on the proximity of items to one another. The spatial associations were then grouped into seven categories, based on the presence/absence of time-diagnostic artifacts, that are designed to be comparable to those used in previous analyses of Archaic and Formative Period assemblages in the region. The Archaic and Formative period projectile point styles were used to classify nonceramic associations; Formative period styles denoting the Formative Lithic category. A projectile point chronology for the region is not yet well-developed, but typologies used are generally consistent with those of previous studies (Carmichael 1983; Hicks 1985; Fields and Girard 1983). If Archaic/Early Formative projectile point styles occurred with ceramics, associations were placed in a multicomponent Mixed category, otherwise they were classed as Archaic. Where Formative period point types occurred with ceramics, associations were placed in one of the ceramically-defined categories described below.

Due to a lack of correspondence of some points with well-described styles, classifications are not completely satisfying. The procedures used here do on the whole, however, serve to distinguish recognized Archaic and Early Formative from other projectile point types (used to denote the Formative Lithic category) and rely on type criteria comparable to those of previous studies. Projectile points inventoried by the project are described in a following portion of this chapter. Several Paleoindian point fragments inventoried during the survey were not used to identify Paleoindian associations, since these had been classified as reworked fragments.

Pottery types were used to differentiate Early Ceramic, corresponding to the Mesilly Phase (A.D. 200 -1100) and Late Ceramic categories, corresponding to the Dona Ana (A.D. 1100 - 1200) and El Paso (A.D. 1100 - 1400) Phases. This classification into Early and Late Ceramic categories separates Whalen's (1980) Late Pithouse Period from Transitional Pueblo and Pueblo Periods. The multicomponent Mixed category also includes associations containing pottery types belonging to both categories. A more detailed description of ceramic types present in West Mesa assemblages is provided in Chapter 7.

These categories were designed to mirror those used in previous analyses of Archaic and Formative Period assemblages in the region. Unspecific Lithic and Ceramic categories account for the bulk of the artifact clusters and Late Ceramic period clusters are the next most frequent category (Table 6.5). It is not surprising that such a relatively small number of artifact associations in this study, and sites in other regional surveys (Carmichael 1983a; Skelton et al. 1981; Whalen 1977, 1978) can be classified to cultural period. Of a total of 8,094 sites listed as discovered in the above referenced surveys only 1,138 or 14 percent (about the same percentage listed here) figured at all incultural-evolutionary explanations based on site temporal distinctions. This situation stems from the fact that most materials discarded in the course of the operation of a human system across a landscape is not temporarily "diagnostic" (see also Whalen 1986:70), but result from the use of utilitarian items and tool maintenance rather than simply from the discard of tools.

Table 6.5. Classified Artifact Clusters.

Category	No.	Percent
MIXED	51	2.84
UNSPECIFIC LITHIC	1,261	70.21
UNSPECIFIC CERAMIC	287	15.98
ARCHAIC	9	.50
FORMATIVE LITHIC	34	1.89
EARLY CERAMIC	20	1.11
LATE CERAMIC	134	7.46

In order to examine the relative contribution of lithic material types to the assemblages in each of the seven temporal categories, the chipped stone was summed for each group of artifact clusters and the percentages of tool types and five general material type categories calculated (Tables 6.6 and 6.7). The lithic raw material classes presented in these tables have been summarized from the material type categories coded for chipped stone during in-field analysis. Obsidians and other glassy volcanics are included in the glassy volcanic category (GVOL); crystalline volcanics (CVOL) include basalts, rhyolites, and indeterminate crystalline volcanic types; cryptocrystallines (CCS) are composed of chert, chalcedony, petrified wood, chalcedonic petrified wood, indeterminate cryptocrystallines; quartzite (QTZ) includes all undifferentiated quartzites;and, sandstones (SS) include sandstone and quartzitic sandstone.

Table 6.6 indicates highest percentages of flakes and debris, most cores and formal tools all occur in the cryptocrystalline material type category, pointing to selection of cryptocrystalline materials for the manufacture of these types on the West Mesa. This pattern is in contrast to one noted for the Tularosa Basin (Carmichael 1983:186) where rhyolite was observed to be the most common material type in Formative period assemblages, but is similar to lithic material inventories from nearby excavations and surveys--the chipped stone assemblages at the site of La Cabrana (Bradley 1983) and at the Keystone Dam sites are dominated by cherts. Cherts also form the majority of materials at surveyed sites lying between Survey Areas 1 and 3 on the West Mesa (Moore and Bailey 1980:Table 6).

Inspecting chipped stone material type percentages by temporal grouping (Table 6.7), cryptocrystallines form the bulk of each assemblage. Highest obsidian frequencies obtain in lithic assemblages associated with Archaic and later period projectile points. These results are not surprising since materials from which projectile points are fashioned contribute to material type counts. In this case, the materials are obsidian and cherts and chalcedonies in the cryptocrystalline category. Projectile point material types are not as well represented in the other groupings simply because assignment to a ceramic period group does not require that a spatial cluster contain points and as a matter of fact criteria for assignment to the Unspecific Lithic category includes lack of points.

The grouped Archaic assemblage contains the highest proportion of siliceous cryptocrystalline materials, but Late Ceramic and Unspecific Lithic and Unspecific Ceramic assemblages are also characterized by high proportions of cryptocrystallines. Clearly, with these general results high proportions of siliceous cryptocrystalline materials are not restricted to a single assemblage category. Coarse- and fine-grained crystalline volcanic materials occur in higher proportions in Early Ceramic and Formative Lithic assemblages. Quartzites and sandstones are present in uniformly low proportions and may occur primarily as the result of groundstone recycling.

Examining the relationships between tool types, lithic materials, and temporal category more closely, Table 6.8 lists the proportions of selected tool types in different material type categories by temporal group. The projectile point bias in Archaic assemblages resulting from use of points as temporally diagnostic indicators is clearly evident in this table; high projectile point frequencies characterize Archaic assemblages since they are by definition only recognized if points are present.

What is of more interest, however, is that highest proportions of cryptocrystalline (CCS) flakes and cores occur in assemblages other than the Archaic--the highest proportion of flakes occurring in the Late Ceramic assemblage and cores and angular debris in the Early Ceramic assemblage. (Variation in the proportion of flakes in each material type category are not due to differences in the proportion of flakes in each temporal group, since each summed assemblage includes roughly equivalent percentages of flakes.) A distinguishing factor for the Archaic assemblage is the low proportion of cryptocrystalline angular debris. A similar pattern is evident in the Formative Lithic assemblage pointing to possible functional similarities between lithic assemblages containing projectile points whether these are stylistically assignable to Archaic or other later periods of occupation. Archaic and later assemblages associated with projectile points are also distinguished by low proportions of crystalline volcanic (CVOL) flakes.

Table 6.6. Chipped stone type percentages in general material type categories.

	Material Types					
Artifact Type	Glassy Volcanics	Crystalline Volcanics	Quartzite	Cryptocrystallines	Sedimentary Rocks	Percentage of Total Assemblage
Chunks and Tested Cobbles	3.62	33.10	5.70	12.52	34.91	5.55
Nonbipolar Cores	5.81	24.09	2.58	63.23	1.29	3.59
Bipolar Cores	69.23			30.77		.10
Angular Debris	1.86	35.61	10.34	43.51	4.66	25.69
Flake Fragments	2.14	27.59	5.68	60.58	1.12	8.28
Flakes	3.47	28.09	7.33	55.55	1.82	54.22
Uniface 0,1,2	9.49	13.87		73.72		1.00
Uniface 3				100.00		.03
Biface 0,1,2	11.58	5.26	5.26	75.79		.73
Biface 3	9.09	9.09	4.55	77.27		.17
Projectile Points	32.20	8.47		57.63		.46
Percentage of Total Assemblage	3.37	30.18	7.57	51.25	4.27	

Table 6.7. Chipped stone material type percentages for periods and phases.

Associations	Glassy Volcanics	Crystalline Volcanics	Quartzite	Cryptocrystallines	Sedimentary Rocks
	Material Types				
Ceramic					
Early Ceramic	1.11	34.56	7.78	48.89	4.44
Late Ceramic	2.21	29.12	6.31	55.35	3.29
Unspecific Ceramic	4.41	29.30	6.57	53.10	3.62
Lithic					
Archaic	6.49	25.97	3.90	59.74	1.30
Formative Lithic	5.40	37.95	6.12	43.17	6.47
Unspecific Lithic	3.00	30.03	8.55	50.58	4.39

Table 6.8. Chipped stone tool and material type percentages in segregated assemblages.

		ARCHAIC	EARLY CERAMIC	LATE CERAMIC	FORMATIVE LITHIC	UNSPEC LITHIC	UNSPEC CERAMIC
ANGULAR DEBRIS	GVOL	0	0	.32	0	.42	.62
	CVOL	3.90	6.67	8.28	18.02	8.57	9.78
	CCS	6.49	16.67	10.32	7.93	11.09	13.03
	SED	1.30	1.11	.65	4.68	1.04	.92
FLAKES	GVOL	3.90	1.11	1.61	3.24	1.91	2.66
	CVOL	12.99	22.22	18.33	17.11	18.29	15.07
	CCS	38.96	20.00	41.24	27.10	34.39	30.14
	SED	0	0	1.08	.36	.96	.71
CORES	GVOL	0	0	.05	.54	.22	.21
	CVOL	1.30	1.11	1.08	.54	.82	.62
	CCS	2.60	3.33	1.94	.90	2.61	2.16
UNIFACE/ BIFACE 1,2	GVOL	0	0	.10	.18	.22	.20
	CVOL	1.30	0	.11	0	.25	.12
	CCS	0	2.22	1.08	1.44	1.54	1.21
UNIFACE/ BIFACE 3	GVOL	0	---	0	.18	0	.04
	CVOL	1.30	---	0	.18	0	0
	CCS	0	---	.11	1.44	.05	.17
PROJECTILE POINTS	GVOL	2.60	---	.05	1.26	---	.21
	CVOL	1.30	---	0	.72	---	0
	CCS	6.49	---	.11	3.06	---	.25
No. Items		77	90	1860	555	6440	2402
No. Clusters		9	20	134	34	1261	287

Obsidian (GVOL) flakes are present in highest proportions in assemblages assigned to groups defined on the basis of projectile points. An analysis of flake morphology (see next section) has indicated that the obsidian flakes do not originate in the process of thinning or resharpening formal tools but are manufactured instead by means of a bipolar flaking technique. This finding suggests evidence for at least 2 strategies of tool production and use at places containing lithic assemblages associated with projectile points: one incorporating carried formal tools and the other expediently produced flakes manufactured from local obsidian nodules.

Highest proportions of crystalline volcanic angular debris and flakes occur in the Formative Lithic and Early Ceramic assemblage, respectively. Though based on relatively few items, this pattern is contrary to the one modeled for El Paso Phase assemblages in which crystalline volcanics make up higher proportions of items than they do in Mesilla Phase lithic inventories.

Though based on relatively few items, this pattern differs from the ones described for the Tularosa Basin (Carmichael 1983:186) and Hueco Bolson (Whalen 1986:75-76). Volcanic rocks make up higher proportions of items in Late Formative El Paso Phase assemblages than they do in Mesilla Phase or Archaic lithic inventories in the Tularosa Basin. This difference has been attributed to a distinction between site types--Mesilla Phase camps (non-midden sites) containing more cherts and El Paso Phase habitation sites containing higher proportions of unmodified rhyolite flakes (Carmichael 1983:186-187). In the Hueco Bolson, a greater abundance of volcanic rocks in Whalen's Puebloan (Late Formative) as opposed to Pithouse (Early Formative) assemblages may in part be due to the differential distribution sites through time--basin-edge Puebloan sites containing more igneous rock available on the basin periphery (Whalen 1986: 75-76).

Variation in the distribution of raw materials and occurrence of settlement types may be more well controlled using West Mesa data. The portion of West Mesa studied here is separated from the nearest primary and secondary source locations of cherts and rhyolites in the Franklins by the Rio Grande Valley with the result that lithic raw material availability does not differ appreciably across the study area. Although the West Mesa scarp is near outcropping Santa Fe gravels, intensively surveyed portions of the study area are not situated in these areas. In addition, portions of the project area, where high densities of Late Formative materials were recognized and a program of subsurface testing indicated midden-like deposits and structural remains, were systematically deleted from the intensive survey. Given the absence of conventionally recognized functional criteria indicative of long-term habitation (i.e., middens and pueblos) and the ubiquitous lack of lithic raw materials, the composition of Early and Late Formative assemblages studied here may be attributed to implementation of similar forms of raw material provisioning including importation of core material and the recycling of archaeological deposits. Similarities between these assemblages may be due to the mixing of deposits due to reuse of the places over very long time periods, as well.

Material Type Variety in Period and Phase Categories

In addressing the issue of whether there is a greater variety and finer texture of chipped stone materials for Mesilla as opposed to El Paso Phase sites, O'Laughlin (1980) points out that an assumption of greater energy expenditure during Mesilla Phase in obtaining raw materials as proposed by Whalen and Thompson (1980) assumes direct procurement strategies. O'Laughlin maintains, as this report has above, that raw material procurement could have easily been incorporated into other activities of highly mobile groups. He alternatively suggests that procurement strategies may have been more direct under semi-sedentary and sedentary conditions with the opposite conclusion that more energy may have been expended in obtaining raw materials by later inhabitants of the region.

Assuming material type variety varies with mobility, O'Laughlin expects a decrease in material variety from Archaic to El Phase Phase time but does not find substantial variation in material type variety through time for assemblages from Keystone Dam Sites 33 and 34. Greater variety is instead attributed to increase in sample size with larger excavated assemblages containing a greater variety of lithic materials. The five most common materials in the local gravels ranked in order of their abundance are: limestone, rhyolite, quartzite, chert, and obsidian. Cherts are far more common in artifact assemblages than they are in gravels, followed by rhyolite as the next most abundant material type for chipped stone with cherts the more common materials for manufacture of small tools including utilized and marginally retouched flakes, projectile points, and bifaces.

Using the six general material types listed in Table 6.6, a simple measure of material type variety was obtained for West Mesa assemblages by averaging the number of material types for spatial associations in each temporal grouping. Average material type variety was obtained for flakes and cores in each temporal category. Comparison of these measures of lithic material variety with the average number of flakes and cores in each category indicates that variety is linked with the number of items contributing to its measurement.

Flake and angular debris material variety is significantly correlated with the mean number of items in spatial associations making up each period or phase category ($r = 0.95$, $p = 0.0006$), higher numbers being related to increased material variety (Table 6.9a). Core material variety is also positively correlated with the average number of cores in spatial associations, though not significantly so ($r = 0.66$, $p = 0.10$). Lack of a significant correlation in the case of cores may stem from their low average number, 1.59, as opposed to higher averages for flakes, 11.69, for period and phase groups (Table 6.9b). These findings are similar to those of O'Laughlin (1980) who notes that rather than increasing through time, material variety for Keystone Dam assemblages is related to sample size.

Shifts in Production Technique and Technological Options

The segregation of lithic assemblages based on associated projectile point styles and ceramic types yields patterns of tool and material type association which are not easily explained by models of raw material use which view the technologies of sedentary systems as unplanned and relying on local materials. Later period assemblages--Early Ceramic, Later Ceramic, and Formative Lithic--each contain cryptocrystalline flakes and debris in high proportions relative to other tool and material types. Since raw materials used in this portion of the Mesilla Bolson may have been selected for their reliable fracturing properties and their flexibility as media for tool recycling rather than as culturally preferred or task specific materials, reliance on proportions of fine-grained siliceous cryptocrystalline materials and coarse-grained crystalline volcanic rocks as temporal indicators in desert basin assemblages may be unwarranted.

Table 6.9a. Mean material type variety and number of flakes and angular debris for spatial associations in period and phase categories.

Category	Variety	Frequency
Mixed	2.64	21.7
Unspecific Lithic	1.81	6.57
Unspecific Ceramic	2.01	10.12
Archaic	1.75	.25
Formative Lithic	2.65	17.00
Early Ceramic	1.84	5.07
Late Ceramic	2.30	14.16

Table 6.9b. Mean material type variety and number of cores for spatial associations in period and phase categories.

Category	Variety	Frequency
Mixed	1.57	1.29
Unspecific Lithic	1.13	1.29
Unspecific Ceramic	1.26	1.65
Archaic	1.50	1.50
Formative Lithic	1.42	1.86
Early Ceramic	1.33	1.33
Late Ceramic	1.27	1.57

One interpretation of the patterns of material type composition presented above is that technological strategies incorporating carried tools and cores and expedient flake production from immediately available raw materials are represented at the locations of projectile point discard. A switch in tool using strategy from use of carried tools to production and use of flakes from carried and expediently manufactured cores is indicated for Archaic and Formative Lithic assemblages. In other words, projectile points are not necessarily used but are simply discarded at places containing Archaic and Formative Lithic assemblages. Planned expedience incorporating a higher incidence of chert reuse may, on the other hand, be a handy technological option frequently employed during later period occupations. With this option, discarded chert artifacts constitute an anticipated, reliable and frequently used source of lithic material in desert basins where raw materials are absent. If this is the case, then later period technologies are not as simply organized as previously thought.

The question arises whether a high incidence of biface production debris as opposed to debris generated during repetitive episodes of tool recycling accounts for similarities in flake morphology among these groups. Only about 3.5 percent of the flakes recorded in the entire West Mesa assemblage were classed as biface thinning or pressure flakes. With such a small proportion, it is likely that the patterns presented here are determined primarily by undifferentiated flake types. The pattern of less cryptocrystalline angular debris in Archaic and Formative Lithic assemblages points to absence of tool recycling, which might generate more angular debris than would reduction of prepared cores, while obsidian flake debris indicates expedient production from local nodules. More cryptocrystalline angular debris in Early, Late, and Unspecific Ceramic assemblages may, on the other hand, indicate systematic chert recycling. The question of similarity in flake reduction stage as measured by flake attributes will be taken up in the following section of this chapter.

With these findings, the suggestion of technological differences as evidenced by variation in proportions of lithic material types between Archaic and later period occupations are in need of reassessment. Rather than emphasis wholly on biface production during the Archaic and flake production during later periods, highest proportions of obsidian flakes associated with Archaic assemblages indicate an element of expedient flake production systematically associated with projectile point discard. High proportions of chert flakes in Archaic, Late Ceramic, and Formative Lithic assemblages may indicate that non-residential tasks performed in desert basins were anticipated with reliance on tool recycling during early and late occupation of the El Paso region.

Flake Attributes

Attributes of flake morphology in West Mesa Surface assemblages are described in this section of Chapter 6. Flakes comprise the largest class of lithic artifacts recorded and therefore are the most reliable indicator of patterning among spatial associations of artifacts. Here, attributes of flake morphology, material type, and patterns of utilization are reviewed for the entire flake assemblage recorded. These attributes are compared among spatial associations of artifacts segregated on the basis of time-diagnostic artifacts. In addition, West Mesa flake assemblages are compared with those recorded at the Keystone Dam Sites in order to distinguish patterns of flake morphology in assemblages on the alluvial slopes of the Franklin Mountains versus the basin floor of the West Mesa.

Relationships between attributes of complete flakes and cores can be examined and compared with those of flakes excavated at the Keystone Dam Site (O'Laughlin 1980; Carmichael 1985) offering the opportunity to assess general differences in flake morphology as they may relate to raw materials provisioning. Flake size and morphology as it relates to the reduction sequence of some distinctive material types have been used as "distance- to-source" indicators (Chapman 1977) and as indicators of group range (Rehrer 1977), flakes becoming smaller and attributes indicative of later portions of the reduction sequence as one moves farther from source locations.

While the logic of this argument makes sense if a direct procurement of raw material is assumed, raw material procurement which relies on planned provisioning from base camps and caches as well as from known archaeological deposits may also account for artifact size differences between areas differing in raw material abundance. With this alternative, artifact size does not necessarily decrease in direct proportion to distance from source location. Rather, geographically defined areas such as desert basin floors and mountain peripheries may exhibit differences in raw material abundance and general differences in artifact size as they relate to provisioning method. Most of the abundant raw material types present in the NHLEP West Mesa Surface assemblage are available at sources in the Franklin Mountains and in alluvial gravels on the mountain slopes. Among the most common of these recognized materials are Rancheria chert and Thunderbird rhyolite.

The more common materials used for chipped stone at the Keystone Dam Sites include dolomite, rhyolite, quartzite, chert, and obsidian which are all present in the local Franklin Mountain gravels on the eastern side of the Rio Grande. Although the ridges flanking the western side of the Rio Grande contain deposits of Sante Fe gravels, small obsidian and chert nodules are the only form of immediately available raw materials on the West Mesa Surface. This lack of immediately available raw materials necessitates importation into the desert basin of materials ranging in form from partially decorticated cores to finished formal tools. A comparison of flake morphology using flake size, cortex, and platform morphology points to differences between Keystone site and West Mesa assemblages that can be attributed to raw material importation in different forms and to recycling of West Mesa Surface chipped stone, particularly cryptocrystalline materials.

General Attributes of the West Mesa Flake Assemblage

The flake attributes of dorsal scar count, amount of dorsal cortex, and platform characteristics when cross tabulated for the entire assemblage of complete flakes indicate that flake production from partially decorticated cores was responsible for the generation of most flake material and that there is little evidence, at least with the surficial survey data, that biface production and maintenance was a dominant manufacturing strategy. Table 6.10 indicates that most flakes are noncortical and their dorsal surfaces distinguished by two to three scars. Of these, most have a noncortical single-facet platforms (Table 6.11); however, the relatively high proportion of flakes lacking dorsal cortex but with cortical platforms may indicate some reliance on a bipolar production technique.

Flake and Core Size

Flake length in the West Mesa Surface assemblage averages 24.69 millimeters and has an interquartile range of 16 to 31 millimeters. It is not possible to compare flake length directly to the Keystone site data since flake metrics have not been presented in published analyses. O'Laughlin does, however, present size class data for utilized and unutilized flakes. Most flakes, an average of 90 percent for Keystone Archaic and Mesilla Phase assemblages, fall into size classes under 4.0 centimeters in maximum dimension as do 90 percent of all NHLEP complete flakes.

West Mesa/Keystone Dam Comparisons

Comparison of NHLEP flake size with the Keystone size class data necessitates collapsing the metric data on flake length into four size classes-- 0-2 centimeters, 21-40 centimeters, 41-60 centimeters, and greater than 60 centimeters. Tables 6.12 and 6.13 list unutilized and utilized flakes in cryptocrystalline, crystalline volcanic, obsidian, and quartzite material types by size class. Segregating flakes into size classes based on material type is one way of controlling for variation in parent core material size as it affects flake size. Since Keystone chert and rhyolite material categories contain the most items and flakes are the most abundant artifact type, items in these categories were compared to the present project data. It should be noted that the cryptocrystalline material type category used here corresponds in a fairly direct way to O'Laughlin's (1980:Table 16) "chert" category which includes chert, chalcedony, and petrified wood and the NHLEP material type "banded chert". However, in addition to rhyolites, smaller amounts of basalt and indeterminate crystalline volcanics are included in the NHLEP crystalline volcanic category and thus may not be as comparable to the Keystone rhyolite category as cryptocrystallines are to Keystone Dam Site cherts.

As Table 6.12 indicates, most NHLEP unutilized flakes are distributed between the two smallest size classes with very few flakes larger than 40 millimeters in length. Obsidian, followed by cryptocrystallines, tends to be more abundant in the small size classes. Looking at only utilized flakes, selection is for those in the 20-40

Table 6.10. Flake cortex and dorsal scar attributes for the West Mes flake assemblage.

DORSAL SCAR COUNT	CORTEX COVER				
PERCENT	None	<50	>50	100	TOTAL
0	0.00	0.00	0.00	4.81	4.81
1	5.59	2.64	4.60	0.00	12.84
2	12.60	5.19	3.14	0.00	20.94
3	16.23	5.51	1.29	0.00	23.03
4	10.22	4.07	0.46	0.00	14.76
5	7.14	2.17	0.23	0.00	9.54
6	4.05	1.25	0.04	0.00	5.34
7	2.03	0.76	0.04	0.00	2.83
8	1.03	0.42	0.04	0.00	1.50
9	3.34	0.93	0.15	0.00	4.41
TOTAL	62.24	22.95	10.01	4.77	100.00 (4737)

Table 6.11. Flake cortex cover and platform characteristics.

CORTEX COVER	PLATFORM			
PERCENT	CORTICAL	SINGLE FACET	MULTIPLE FACET	
0	20.94	36.75	4.60	62.30
<50	9.48	12.14	1.33	22.95
>50	4.52	4.83	0.63	9.99
100	3.25	1.44	0.08	4.77
TOTALS	38.29	55.16	6.65	100.00 (4737)

Table 6.12. Cross tabulation of NHLEP unutilized flake material type by size class.

```
MATERIAL TYPE                    SIZE CLASS


        FREQUENCY!
         PERCENT !
         ROW PCT !
         COL PCT !0-2     !2-4     !4-6     !>6      !  TOTAL
        ---------+--------+--------+--------+--------+
        CHERT    !   1808 !   1515 !    130 !      9 !   3462
                 !  29.77 !  24.95 !   2.14 !   0.15 !  57.01
                 !  52.22 !  43.76 !   3.76 !   0.26 !
                 !  61.98 !  54.54 !  36.93 !  34.62 !
        ---------+--------+--------+--------+--------+
        CRYST VO !    709 !   1000 !    190 !     12 !   1911
                 !  11.67 !  16.47 !   3.13 !   0.20 !  31.47
                 !  37.10 !  52.33 !   9.94 !   0.63 !
                 !  24.31 !  36.00 !  53.98 !  46.15 !
        ---------+--------+--------+--------+--------+
        OBSIDIAN !    168 !     50 !      1 !      0 !    219
                 !   2.77 !   0.82 !   0.02 !   0.00 !   3.61
                 !  76.71 !  22.83 !   0.46 !   0.00 !
                 !   5.76 !   1.80 !   0.28 !   0.00 !
        ---------+--------+--------+--------+--------+
        QUARTZITE!    232 !    213 !     31 !      5 !    481
                 !   3.82 !   3.51 !   0.51 !   0.08 !   7.92
                 !  48.23 !  44.28 !   6.44 !   1.04 !
                 !   7.95 !   7.67 !   8.81 !  19.23 !
        ---------+--------+--------+--------+--------+
        TOTAL        2917     2778      352       26     6073
                    48.03    45.74     5.80     0.43   100.00
```

MATERIAL TYPE	SIZE CLASS	PERCENT NHLEP FLAKES	PERCENT KEYSTONE FLAKES*	
	N=	3462	1574	
CHERTS	0-2CM	52.22	57.5	
	2-4CM	43.76	38.8	Chi= 12.26
	4-6CM	3.76	3.5	p= 0.0065
	> 6CM	.26	.2	
	N=	1911	631	
CRYST	0-2CM	37.10	39.6	
VOLCANIC	2-4CM	52.33	43.8	Chi= 37.56
	4-6CM	9.94	13.4	p 0.0001
	> 6CM	.63	3.2	
	N=	219	30	
OBSIDIAN	0-2CM	76.71	90.0	
	2-4CM	22.83	10.0	n.s.
	4-6CM	.46	0	
	>6CM	0	0	
	N=	481	484	
QUARTZ	0-2CM	48.23	48.0	
ITE	2-4CM	44.28	40.2	n.s.
	4-6CM	6.44	10.3	
	>6CM	1.04	1.4	

NOTE: * Based on frequencies and percentages as given in O'Laughlin 1980: Tables 19 and 20.

Table 6.13. Cross tabulation of NHLEP utilized flake material type by size class.

MATERIAL TYPE FREQUENCY PERCENT ROW PCT COL PCT	SIZE CLASS 0-2	2-4	4-6	>6	TOTAL
CRYPTO	62	244	65	4	375
CRYSTAL	11.21	44.12	11.75	0.72	67.81
LINE	16.53	65.07	17.33	1.07	
	77.50	69.52	59.63	30.77	
CRYST	10	68	38	6	122
VOLCANIC	1.81	12.30	6.87	1.08	22.06
	8.20	55.74	31.15	4.92	
	12.50	19.37	34.86	46.15	
OBSIDIAN	7	16	0	0	23
	1.27	2.89	0.00	0.00	4.16
	30.43	69.57	0.00	0.00	
	8.75	4.56	0.00	0.00	
QUARTZITE	1	23	6	3	33
	0.18	4.16	1.08	0.54	5.97
	3.03	69.70	18.18	9.09	
	1.25	6.55	5.50	23.08	
TOTAL	80	351	109	13	553
	14.47	63.47	19.71	2.35	100.00

MATERIAL TYPE	SIZE CLASS	PERCENT NHLEP FLAKES	PERCENT KEYSTONE FLAKES*	
	N=	375	171	
CHERTS	0-2CM	16.53	23.4	
	2-4CM	65.07	62.6	n.s.
	4-6CM	17.33	12.9	
	>6CM	1.07	1.2	
	N=	122	12	
CRYST VOLCANIC	0-2CM	8.20	0	
	2-4CM	55.74	0	
	4-6CM	31.15	0	
	>6CM	4.92	100.0	
	N=	23	5	
OBSIDIAN	0-2CM	30.43	100.0	
	2-4CM	69.57	0	
	4-6CM	0	0	
	>6CM	0	0	
	N=	33	28	
QUARTZ-	0-2CM	3.03	21.3	
ITE	2-4CM	69.70	57.9	n.s.
	4-6CM	18.18	16.7	
	>6CM	9.09	4.1	

NOTE: * Based on frequencies and percentages as given in O'Laughlin 1980: Tables 19 and 20.

millimeter size class with slightly higher proportions than unutilized flakes in the 40-60 millimeter size class (Table 6.13). Comparison of these measures with the Keystone flake size data are interesting. Table 6.12 demonstrates a significant difference in unutilized flake size between Keystone assemblages and the NHLEP flake data for cherts and crystalline volcanic rocks. Slightly higher percentages of small chert flakes occur in the Keystone Dam Site assemblage and may be attributable to the fact that excavated materials at Keystone Dam may include smaller items than do the West Mesa Surface assemblages (see Chapter 9 discussion). If differences in collection methods are structuring the results of the size comparisons, then all excavated material types should exhibit higher percentages of small flakes, however, crystalline volcanic flakes are slightly larger in the Keystone Dam Site assemblages than they are in the West Mesa collections. In addition, no difference was found between unutilized obsidian and quartzite flakes recorded by each project. No significant differences in utilized flake size were found between flakes recorded by each project in any material type category possibly indicating a universal pattern in the selection of certain sized flakes for utilization.

These findings suggest a relatively small core size for crystalline volcanic flakes in the West Mesa assemblage which may be due to the importation of prepared partially decorticated core material and to the recycling of volcanic groundstone as cores. In contrast, Keystone sites are located in areas of ubiquitous volcanic raw materials. Table 6.14a lists NHLEP artifacts that fit O'Laughlin's (1980:165) definition of a core by material type and two general size classes. Using two general size classes, one above and the other below or equal to 6 centimeters, enables comparison of the West Mesa and Keystone Dam data sets each of which was originally measured in a slightly different manner. Published data on Keystone cores includes four size classes similar to those of flakes described above, while West Mesa core size classes were defined using four size classes: 0-3, 3-6, 6-10, and greater than 10 centimeters.

Using the two general size classes, there is no difference between NHLEP and Keystone core size in the chert and obsidian categories (Table 6.14b). Lack of size differences in these items between the two areas suggests that chert core materials are introduced into this area in sizes equivalent to those in areas near the Franklin Mountains where chert is more abundant. Obsidian occurs in each area as similar-sized nodules. Differences do exist, however between crystalline volcanic and quartzite core size, these being significantly larger at Keystone Dam Sites 33 and 34. The latter results, though based on an overall small number of cores may indicate that rhyolite and quartzite raw material which is more abundant at the Keystone sites, is being used in a direct manner there compared with the core reutilization and thus smaller volcanic rock core size on the West Mesa. Chert cores, on the other hand, may represent carried and maintained implements in both settings.

Assemblages by Temporal Group

Comparing spatial associations grouped into temporal categories for differences in flake size, several patterns which may be indicative of places which were reused on a more intensive basis can be found. First, platform-bearing chert flakes in Late Ceramic associations are significantly smaller that those in Unspecific Ceramic (Chi= 15.28, p=.0004), Unspecific Lithic (Chi=41.50, p .001), and Early Ceramic (Chi=10.04, p=066) associations, but flakes in Archaic and Formative Lithic associations do not differ from other associations (Table 6.15).

Crystalline volcanic flakes in Late Ceramic period assemblages are also significantly smaller than those in Unspecific Lithic assemblages (Chi= 10.76, p= .013). If smaller flake size indicates more intensive reuse of core materials, then it may be that places containing late Formative period ceramics were the targets of reuse to a greater degree than other places lacking these types of ceramics. In all, 137 artifact associations containing some 1,860 chipped stone and 374 groundstone artifacts were designated Late Ceramic. Together these associations contain the full range of artifact types that may have been deposited along with late period ceramics as well as items deposited at previous times. Given that the Late Ceramic assemblage so defined is certainly a composite, it does not seem that functional differences alone could account for variation in flake size between Late Ceramic assemblages and other associations. However, reuse of satellite field locations from a main residence, one of the characteristics outlined for sedentary settlement systems, may account for such a pattern.

Table 6.14a. Cross tabulation of material types and general size class for all cores as defined by O'Laughlin (1980).

```
    MATERIAL TYPE        SIZE CLASS

     FREQUENCY!
      PERCENT !
      ROW PCT !
      COL PCT !<= 6cm  ! >6cm   !  TOTAL

----------+--------+--------+------
     CRYPTO    !    402 !     25 !    427
     CRYSTAL   !  64.01 !   3.98 !  67.99
     LINE      !  94.15 !   5.85 !
               !  68.84 !  56.82 !
---------------+--------+--------+
     CRYST     !    112 !     18 !    130
     VOLCANIC  !  17.83 !   2.87 !  20.70
               !  86.15 !  13.85 !
               !  19.18 !  40.91 !
---------------+--------+--------+
     OBSIDIAN  !     55 !      0 !     55
               !   8.76 !   0.00 !   8.76
               ! 100.00 !   0.00 !
               !   9.42 !   0.00 !
---------------+--------+--------+
     QUARTZITE !     15 !      1 !     16
               !   2.39 !   0.16 !   2.55
               !  93.75 !   6.25 !
               !   2.57 !   2.27 !
---------------+--------+--------+
     TOTAL          584       44     628
                  92.99     7.01  100.00
```

Table 6.14b. Comparison of NHLEP and KEYSTONE core size by material type.

		PERCENT NHLEP CORES	PERCENT KEYSTONE DAM SITES 33 and 34 CORES*	
CHERT	N	427	83	
	<=6CM	94.15	95.18	
	> 6CM	5.85	4.82	n.s.
CRYSTAL	N	130	15	
LINE	<=6CM	86.15	33.33	chi= 20.80
VOLCANIC	> 6CM	13.85	66.66	p< 0.001
OBSIDIAN	N	55	3	
	<=6CM	100.00	100.00	
	>6CM	0	0	
QUARTZITE	N	16	26	chi= 6.67
	<=6CM	93.75	50.00	p= 0.009
	>6CM	6.25	50.00	

NOTE: *Based on frequencies and percentages as given in O'Laughlin 1980: Tables 19 and 20.

Table 6.15. Distribution of unutilized chert flake size by periods and phases.

TEMPORAL GROUP	SIZE CLASS 0-2	2-4	4-6	>6	N
Unspecific Lithic	48.06	47.28	4.30	.36	1693
Unspecific Ceramic	52.31	43.82	3.73	.15	671
Archaic	50.00	42.31	7.69	0	26
Formative Lithic	56.78	39.83	3.39	0	118
Early Ceramic	50.00	33.33	16.67	0	12
Late Ceramic	63.12	34.65	2.23	0	583
Totals	52.59	43.53	3.65	.24	3373

Flake Cortex

The amount of cortical covering on the dorsal surface of flake can be used to gauge relative amount of core reduction prior to detachment of that flake. Flakes whose dorsal surface is completely cortical are produced during the initial stages of core reduction, while those lacking cortex are generated after the cortical rind has been removed from the parent core material. Activities revolving around decortication of core material produce flake assemblages containing high percentages of cortical flakes. Decortication followed by production of high frequencies of non-cortical flakes produces assemblages which may seemingly have been generated during later stages of reduction since cortical mass is less than that of the rest of a decorticated core.

West Mesa/Keystone Dam Comparisons

A majority of unutilized chert flakes recorded on the West Mesa lack dorsal cortex as do unutilized chert flake assemblages at Keystone Sites 33 and 34. Approximately 10 percent more of the West Mesa assemblage is non-cortical (Table 6.16), however, a difference that is statistically significant (Chi=32.9, $p = 0.0001$, d.f.=1). Highest percentages of flakes of fine-grained materials are classed as secondary (less than half of the dorsal surface is covered with cortex) for Keystone Dam Sites 36 and 37. The difference in the frequencies flakes in three cortex categories (none, <50 percent and >50 percent) between these Keystone assemblages and the NHLEP chert flake assemblage is also statistically significant (Site 36, Chi=120.08, $p > 0.0001$; site 37, Chi=263.54, $p < 0.0001$).

This result is interesting since the smaller size of chert flakes in the Keystone Dam Site assemblages than in the West Mesa flake assemblage suggests that cores are further reduced at the sites nearer to the Franklin Mountains leading to an expectation for higher proportions of non-cortical flake debris there as well. It could be that size differences demonstrated above stem in large part to a size bias introduced into this study by comparing West Mesa Surface to Keystone Dam Site surface and excavated materials--smaller items tending to be less likely exposed and therefore more likely to be recovered during excavation rather than survey data. It appears, however, that a higher proportion of surficial flake debris on the West Mesa is noncortical in comparison to surficial and excavated debris at Keystone Dam Sites.

This is not the case for crystalline volcanic materials. No difference in the amount of non-cortical flake debris exists between the NHLEP crystalline volcanic flake assemblages and Keystone Dam rhyolite assemblages. Approximately 37 and 38 percent of the volcanic rock flakes in NHLEP and Keystone Dam Sites 33 and 34 assemblages respectively are cortical suggesting flake production from parent core materials in similar stages of decortication. It may be that recycling of volcanic rock artifacts on the West Mesa, if it did occur with any frequency involved core materials which were not initially decorticated to any great degree. Lack of cortex differences between the volcanic flake assemblages probably indicates similar forms of core material. In the case of Keystone Dam assemblages, it is raw material including large and small rhyolite rocks in the local gravels. Similarities in the amount of cortical volcanic material on the West Mesa, suggests that much of it may have been imported in fully cortical form. Coarse-grained rhyolite hammerstones, for example, if recycled for flake production would have served as wholly cortical cores.

No differences exist between NHLEP and Keystone Sites 33 and 34 assemblages in amount of cortical material in unutilized obsidian and quartzite flakes, as well. This is understandable in the case of obsidian since it is present in both areas in the form of small nodules. No significant difference was found in the proportions of cortical and non-cortical quartzite flake debris between the two assemblages possibly because cortical quartzite flakes on the West Mesa occur as the result of groundstone recycling.

Assemblages by Temporal Group

Comparing West Mesa flake assemblages in different period and phase categories, Late Ceramic and Formative Lithic flake assemblages are each significantly different from Unspecific Lithic and Unspecific Ceramic assemblages in that they contain higher percentages of non-cortical chert flakes (Table 6.17). Crystalline volcanic flakes in Late Ceramic assemblages also occur in

Table 6.16. Percentages of cortical and non-cortical flakes in West Mesa and Keystone Dam Sites 33 and 34 assemblages.

		Cortex Absent	Cortex Present	N	
Chert	West Mesa	67.58	31.41	3381	Chi= 47.34
	Keystone*	58.17	41.83	1574	$p < 0.0001$
Volcanic Rocks	West Mesa	61.95	36.92	1869	n.s.
	Keystone	61.49	38.51	631	
Obsidian	West Mesa	50.45	49.54	218	n.s.
	Keystone	43.33	56.67	30	
Quartzite	West Mesa	61.78	40.98	471	n.s.
	Keystone	65.74	33.97	467	

NOTE: *Based on frequencies and percentages as given in O'Laughlin 1980:Tables 19 and 22.

Table 6.17. Distribution of chert flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL GROUP	CORTEX CATEGORY NONE	< 50%	> 50%	100%	N
Unspecific Lithic	65.34	22.10	8.34	3.04	1,679
Unspecific Ceramic	65.73	19.14	10.68	3.41	674
Archaic	61.54	23.08	11.54	3.85	26
Formative Lithic*	78.81	12.71	6.78	1.69	118
Early Ceramic	66.67	25.00	0	0	12
Late Ceramic**	73.80	16.44	5.82	3.08	584
Totals	67.58	20.11	8.17	3.10	3,381

NOTES: * Different from:
Unspecific Lithic Chi=8.43, p= .0037, d.f. =3
Unspecific Ceramic Chi=7.21, n.s.

**Different from:
Unspecific Lithic Chi=14.86, p= .0019, d.f. =3
Unspecific Ceramic Chi=13.08 p= .004

Table 6.18. Distribution of crystalline volcanic flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL GROUP	CORTEX CATEGORY NONE	<50%	>50%	100%	N
Unspecific Lithic*	59.96	21.76	8.95	5.10	979
Unspecific Ceramic	60.69	23.99	6.36	6.93	346
Archaic	62.50	25.00	12.50	0	8
Formative Lithic	63.64	28.57	5.19	2.60	77
Early Ceramic	90.00	5.00	5.00	0	20
Late Ceramic**	70.00	18.21	7.86	3.93	280
Totals	61.96	21.67	9.95	5.29	1,869

NOTES: *Different from:
Unspecific Ceramic Chi= 9.76, p= 0.026

**Different from:
Unspecific Lithic Chi= 8.66, p= .034, d.f. =3

higher proportions, 70 percent, in the non-cortical category than they do in Unspecific Lithic assemblages, 59.96 percent (Table 6.18), a significant difference (Chi =9.76, p = 0.34, d.f.=3). Higher proportions of non-cortical quartzite flakes occur in Late Ceramic assemblages, 74.62 percent, than in Unspecific Lithic assemblages, 57.58 percent, as well (Table 6.19). Obsidian flake proportions in various cortex classes (Table 6.20) do not differ significantly between any assemblages.

In summary, Late Ceramic flake assemblages which include chert, crystalline volcanic rocks, and quartzite contain a significantly higher proportion of non-cortical flake debris than do Unspecific Lithic assemblages indicating the association of late period ceramics with flake debris generated from cores which are "more reduced" than those associated with only lithic material or unspecific brownwares. Various interpretations can be offered for the origin and form of this more reduced core material, including prepared cores that are relatively small compared to those in other associations, finished recycled tools, and other debris. With the first alternative, areas containing late period ceramics could be the locations for activities involving a specific form of core material, and, in the others, previously used places may have been targeted for relatively intensive reuse. Similar to Late Ceramic assemblages, Formative Lithic assemblages contain more non-cortical chert flakes than do the Unspecific Lithic group.

Table 6.19. Distribution of quartzite flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL GROUP	CORTEX CATEGORY NONE	<50%	>50%	100%	N
Unspecific Lithic	57.68	22.41	10.37	8.29	241
Unspecific Ceramic	72.55	13.73	5.88	6.86	102
Archaic	66.66	33.33	0	0	3
Formative Lithic	83.33	11.11	5.55	0	18
Early Ceramic	0	100.00	0	0	1
Late Ceramic*	74.62	14.93	10.45	0	67
Totals	65.18	19.53	8.49	5.94	471

NOTE: * Different from:
Unspecific Lithic Chi=9.35, p= .0294, d.f. =3

In comparison to the unutilized flake assemblage discussed above, utilized flakes are distributed somewhat differently with respect to cortex class (Table 6.21). The proportion of non-cortical flakes is lower for utilized flakes in each material type category than it is for unutilized material. From a review of the flake size data presented above, it appears that selection for utilized flake material concentrated on flakes in the 2 - 4 millimeter length range. Since more smaller flakes produced farther along in a core reduction sequence are non-cortical, the higher proportion of cortical utilized flakes may occur as the result of a mean utilized flake size which is larger than that of unutilized flake debris.

In addition, there is a relatively high percentage of cortical obsidian flakes in the utilized assemblage compared with that of other material types which is referable to the use of local nodules.

Table 6.20. Distribution of unutilized glassy volcanic flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL GROUP	CORTEX CATEGORY NONE	<50%	>50%	100%	N
Unspecific Lithic	58.16	21.43	10.20	10.20	98
Unspecific Ceramic	50.00	28.85	13.46	7.69	52
Archaic	50.00	0	0	50.00	2
Formative Lithic	41.18	23.53	23.53	11.76	17
Early Ceramic	0	0	0	100.00	1
Late Ceramic*	44.00	32.00	12.00	12.00	25
Totals	50.46	25.69	11.93	11.93	218

Table 6.21. Distribution of utilized flakes in material type and cortex classes.

MATERIAL TYPE	CORTEX CATEGORY NONE	< 50%	>50%	100%	N
Chert	56.30	26.89	12.32	2.80	357
Volcanic Rock	47.71	29.36	13.76	6.42	109
Quartzite	41.94	22.58	32.26	3.23	31
Obsidian	30.43	26.09	26.09	17.39	23

No significant differences in the amount of dorsal cortex were found between utilized chert flakes from different periods and phases. With the exception of some very small flake assemblages (Archaic and Early Ceramic), proportions in each cortex class are fairly regular (Table 6.22). The utilized flake assemblages composed of crystalline volcanic materials are relatively small owing to the lower overall frequency of this material (Table 6.23) and to the difficulty in distinguishing edge modification on coarse-grained rhyolites (Foix and Bradley 1985:119).

A lack of utilized crystalline volcanic flakes in the Archaic and Formative Lithic assemblages contrasts with those of other periods and phases. Higher frequencies of utilized volcanic rock flakes occur in the Unspecific Lithic and Ceramic categories which differ from each other in that Unspecific Lithic flake assemblages contain more non-cortical and fewer cortical flakes than does the Unspecific Ceramic assemblage (Chi=10.97, p= 0.011, d.f.= 3). Too few obsidian and quartzite flakes were utilized from any statistical comparisons to be made.

Table 6.22. Distribution of utilized chert flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL	CORTEX CATEGORY				
GROUP	NONE	<50%	>50%	100%	N
Unspecific Lithic	57.75	25.82	12.68	2.35	213
Unspecific Ceramic	45.65	30.43	10.87	8.70	46
Archaic	50.00	25.00	25.00	0	4
Formative Lithic	56.25	37.50	6.25	0	16
Early Ceramic	25.00	50.00	25.00	0	4
Late Ceramic	56.25	27.08	12.50	2.08	48
Totals	56.30	26.89	12.32	2.80	357

Table 6.23. Distribution of utilized crystalline volcanic flakes in cortex classes for assemblages assigned to period and phase categories.

TEMPORAL	CORTEX CATEGORY				
GROUP	NONE	<50%	>50%	100%	N
Unspecific Lithic	39.66	26.21	15.52	5.17	58
Unspecific Ceramic	68.75	0	18.75	6.25	16
Archaic	50.00	50.00	0	0	2
Formative Lithic	40.00	60.00	0	0	5
Late Ceramic	60.00	20.00	15.00	5.00	20
Totals	47.71	29.36	13.76	6.42	109

Platform Types

The presence and absence of cortex on the flake platform and flakes with truncated platforms are the platform attributes most consistently coded during in-field analysis. Comparing these attributes, a majority of flakes of all material types are characterized by noncortical platforms (Table 6.24) with utilized flakes exhibiting slightly higher percentages of cortical platforms.

Table 6.24a. Distribution of unutilized flakes in platform classes material types.

Material	PLATFORM CLASS			
Type	MISSING	CORTICAL	NONCORTICAL	N
Chert	6.91	27.10	64.05	3369
Volcanic	4.46	38.72	50.16	1862
Quartzite	4.89	31.28	57.87	470
Obsidian	8.33	55.09	34.26	216

Table 6.24b. Distribution of unutilized flakes in platform classes material types.

Material Type	PLATFORM CLASS MISSING	CORTICAL	NONCORTICAL	N
Chert	5.34	33.71	58.43	356
Volcanic	4.55	40.91	52.73	110
Quartzite	0	25.81	70.96	31
Obsidian	8.70	65.22	26.08	23

West Mesa/Keystone Dam Comparisons

The proportion of flake debris with platform cortex differs between Keystone Dam Sites 33 and 34 and the West Mesa assemblage (Table 6.25) in the anticipated fashion given expectations for chert recycling and for expedient use of any knappable local gravels.

Table 6.25. West Mesa and Keystone Dam Sites 33 and 34 flake percentages with cortical and non-cortical platforms (percentages based on total frequency of cortical and non-cortical platforms only).

Material Type	West Mesa	Keystone Dam Sites 33 and 34*	
Chert			
Cortical	29.73	34.12	Chi= 7.10
Non-cortical	70.27	65.88	p= 0.0076
Crystalline Volcanic Rocks			
Cortical	43.56	46.05	
Non-cortical	56.44	53.95	n.s.
Quartzite			
Cortical	35.08	38.14	
Non-cortical	64.92	61.86	n.s.
Obsidian			
Cortical	61.66	35.00	Chi= 4.28
Non-cortical	38.34	65.00	p= 0.038

NOTE: *Based on frequencies and percentages as given in O'Laughlin 1980: Tables 19 and 24.

More chert flakes on the West Mesa have non-cortical platforms indicating less cortical surface on imported core material since chert cores in both areas have been shown to occur in similar size ranges. More obsidian flake debris is non-cortical on the West Mesa as well, suggesting more intensive reduction of local obsidian nodules on the West Mesa due to lack of other local knappable raw materials. Crystalline volcanic and quartzite flakes in each area have similar proportions of cortical and non-cortical platforms. Possibly because of the same reasons that flake proportions in dorsal cortex classes do not differ: importation of cortical raw material, use of groundstone artifacts as cores, and production of relatively large flakes.

Assemblages by Temporal Group

Differences in platform morphology among chert flake assemblages assigned to period and phase categories appear to be related to the abundance of truncated platforms rather than presence of platform cortex. Late Ceramic chert flakes contain a significantly higher proportion of flakes with missing platforms (Table 6.26a) and therefore fewer non-cortical flakes than do flakes in Unspecific Lithic assemblages (Chert: Chi= 9.17, p= 0.01, d.f= 3).

Similar flake proportions among period and phase categories prevail in missing, cortical, and noncortical platform classes for other material types (Table 6.26b,c,d). More than half of the Formative Lithic quartzite flakes have cortex present on their platforms (Table 6.26c), but this small assemblage is only significantly different from Unspecific Ceramic quartzite flakes (Chi= 7.00, p= 0.03, d.f.= 3) which have predominantly non-cortical platforms. With the exception of the very smallest assemblages, proportions of crystalline volcanic and obsidian flakes in different platform classes are relatively uniform for period and phase categories.

Table 6.26a. Platform category by period and phase for unutilized chert flakes. Indeterminate and other platform types are not listed as percentages but are included in row totals.

ASSEMBLAGE CATEGORY	PLATFORM CLASS Missing*	Cortical	Noncortical	N
Unspecific Lithic	6.29	26.86	64.93	1668
Unspecific Ceramic	7.00	28.46	63.34	671
Archaic	3.85	23.08	3.08	26
Formative Lithic	4.24	25.42	67.80	118
Early Ceramic	8.33	41.67	50.00	12
Late Ceramic	9.93	26.88	60.62	584
Totals	6.91	27.10	64.05	3369

Table 6.26b. Platform category by period and phase for unutilized crystalline volcanic flakes. Indeterminate and other platform types are not listed as percentages but are included in row totals.

ASSEMBLAGE CATEGORY	PLATFORM CLASS Missing	Cortical	Noncortical	N
Unspecific Lithic	4.10	37.64	51.18	975
Unspecific Ceramic	5.51	38.84	54.49	345
Archaic	0	50.00	50.00	8
Formative Lithic	5.19	37.66	57.14	77
Early Ceramic	10.00	35.00	55.00	20
Late Ceramic	4.64	45.35	47.56	280
Totals	4.46	38.72	50.16	1862

Table 6.26c. Platform category by period and phase for unutilized quartzite flakes. Indeterminate and other platform types are not listed as percentages but are included in row totals.

ASSEMBLAGE CATEGORY	PLATFORM CLASS Missing	Cortical	Noncortical	N
Unspecific Lithic	4.15	32.37	57.26	241
Unspecific Ceramic	2.97	26.73	65.35	101
Archaic	0	0	66.67	3
Formative Lithic	5.56	55.56	33.33	18
Early Ceramic	0	0	0	1
Late Ceramic	11.94	28.36	53.73	67
Totals	4.89	31.28	7.87	470

Table 6.26d. Platform category by period and phase for unutilized glassy volcanic flakes. Indeterminate and other platform types are not listed as percentages but are included in row totals.

ASSEMBLAGE CATEGORY	PLATFORM CLASS Missing	Cortical	Noncortical	N
Unspecific Lithic	8.25	51.55	8.14	97
Unspecific Ceramic	11.76	62.75	23.53	51
Archaic	0	50.00	50.00	2
Formative Lithic	11.76	47.06	35.29	17
Early Ceramic	0	0	100.00	1
Late Ceramic	4.00	56.00	36.00	25
Totals	8.33	55.09	34.26	216

NOTE: *Indicates nearly complete flake except for truncated platform.

Flake Stage

The variable STAGE is designed to be an indicator of how early or late in the sequence of reducing a core a flake was removed. Four factors contribute to this "reduction score": type of platform, amount of dorsal cortex, dorsal scar count density, and flake thinness. Because there is no clear consensus in the lithic reduction literature that one of these factors contributes more information about stage of reduction than the others, the STAGE index is calculated from all of these factors weighted so that all are approximately equal, as discussed below.

STAGE is determined for flakes that were coded as undifferentiated, pressure, or biface thinning flakes (bipolar flakes were not included) and that were complete. Only those flakes for which all variables of CORTEX, PLATFORM, DSC, LENGTH, and THICK were coded are considered. PLATFORM codes include: 0 (platform missing), 1 (cortical platform), 3 (single-facet platform), and 4 (multi-faceted platform). A flake with a missing platform is not included. CORTEX was coded in the field to range from 0 (no cortex) to 3 (100 percent cortex); the rank of this variable was inverted so that it would trend in the same direction as the other variables for which a low value indicates early removal and a higher value indicates later removal. THIN, the index of flake thinness, is calculated by dividing length by thickness. The larger the value for THIN, the relatively thinner the flake, given its length. A similar size standardization is done for dorsal scar count (DSC) to ensure that not all large flakes, which might bear more dorsal scars just because of their size, are not automatically assigned to a later stage than smaller flakes. Thus, DSCDEN, the dorsal scar count density is calculated by dividing DSC by LENGTH.

Each of the contributing variables of PLATFORM, CORTEX, THIN, DSCDEN, have a different range (see Figure 6.3) so that to simply add their values would result in an index solely dominated by THIN, which ranges from 0.2 to 49. Therefore, to equalize the weight of each variable, some amount of variable variance "stretching" and "compressing" was performed so that each variable would range approximately between 0 and 10 as in Table 6.27 (see Figure 6.3b). Obviously, the decision to make the CORTEX variable equal to .825 rather than 1.333 is completely arbitrary. The values used to stretch or compress the continuous variables of DSCDEN and THIN were determined after inspecting the distributions of DSCDEN and THIN values.

Table 6.27. Variable values used to calculate STAGE

Variable	Field Code	Translation	New Value
PLATFORM	0	missing	N/A
	1	cortical	1.5
	2	crushed	N/A
	3	single-facet	5.0
	4	multiple-facet	8.5
CORTEX	3	100%	.875
	2	50 - 99%	3.625
	1	1 - 50%	6.375
	0	0%	9.125

DSCDEN = (DSC / LENGTH) x 8.88889

(stretches 0-1.25 to 0-10)

THIN = ((LENGTH / THICK) x 0.204918) - 0.040982

(compresses .2-49 to 0-10)

The new variables are then summed to determine the "prestage" index which ranges from 2.375 to 25 for the NHLEP assemblage. Note that the maximum of 37.625 (the sum of the maximum possible values for each of the four variables) was not found. To bound the universe of STAGE to limits more easily remembered than 2.375 - 26, the index was once again scaled so that it ranged between 0 and 10.

Flake stage and some of the measures used to calculate flake stage were compared between the inventory of complete flakes in four main material type categories and for those in period and phase categories. The measures listed for material types (Table 6.28) indicate expedient flake production using glassy volcanics and

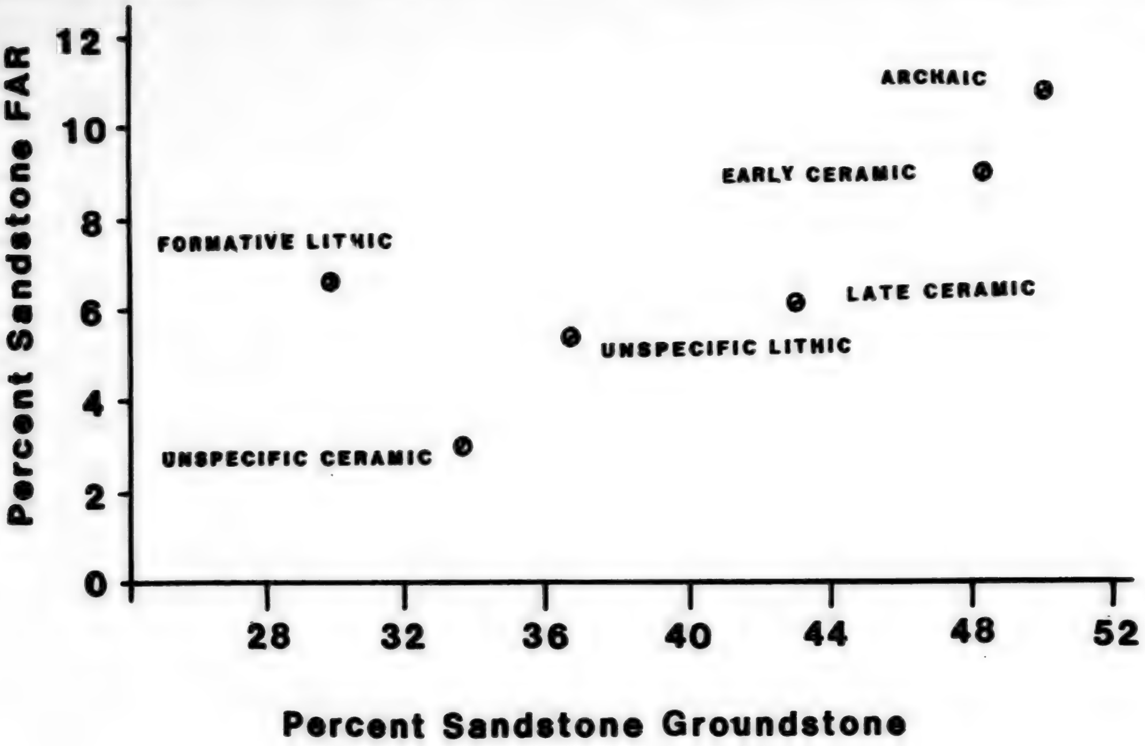


FIGURE 6.1.
RELATIONSHIP BETWEEN PROPORTIONS OF SANDSTONE
GROUNDSTONE AND FAR IN SUMMED ASSEMBLAGES.

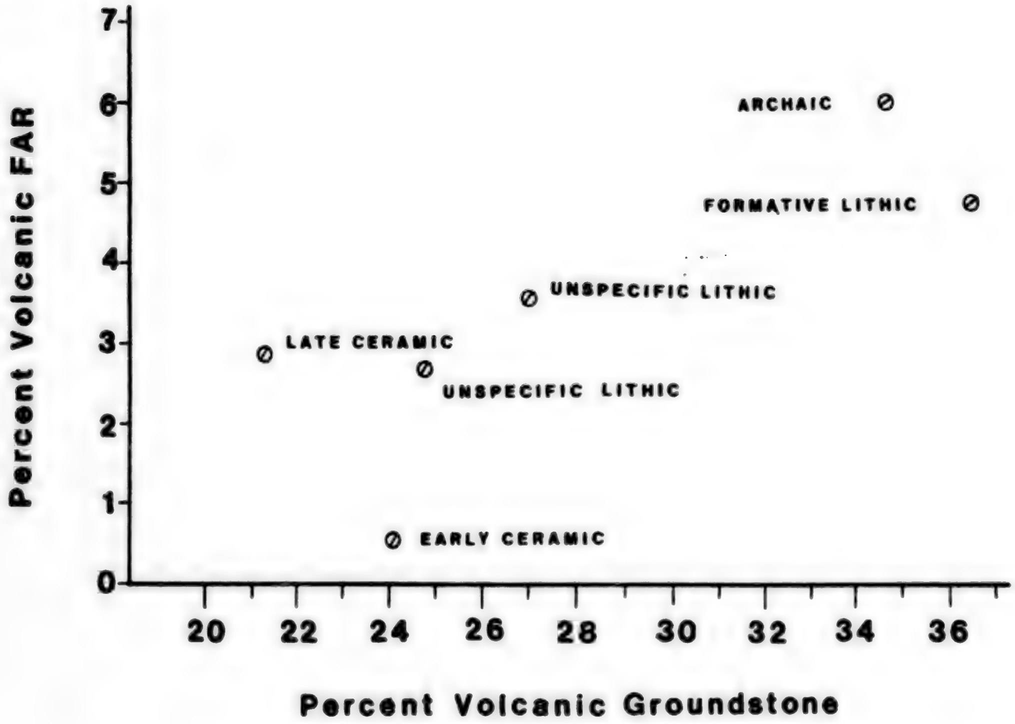


FIGURE 6.2.
RELATIONSHIP BETWEEN PROPORTION OF VOLCANIC ROCK
GROUNDSTONE AND FAR IN SUMMED ASSEMBLAGES.

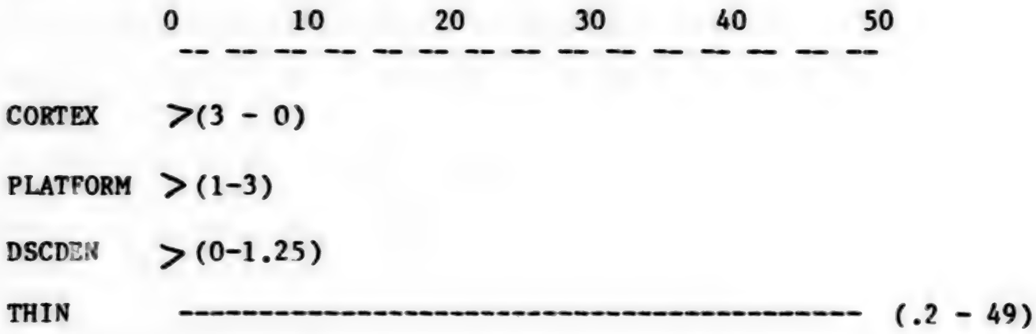
212

BLANK

PAGE

Figure 6.3. Ranges of Variables Contributing to STAGE index (a) before and (b) after stretching/compressing

(a) Ranges of Variables Contributing to Stage Index



(b) Ranges of Stretch/Compressed Variables Contributing to Stage Index

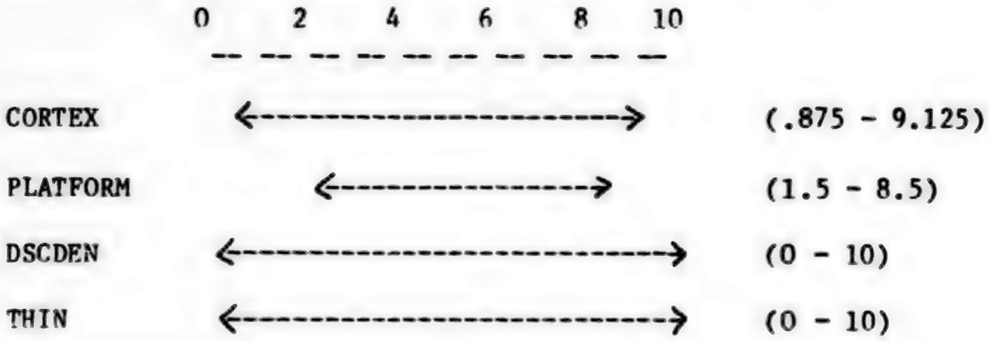


Table 6.28. Mean flake attribute values by material type. a/

	Len	Thick	DSC	Cortex	Platform	Stage	N*
Glassy Volcanics	17.53	4.45	2.82	.90	1.36	4.11	160
Crystalline Volcanics	27.09	7.42	2.97	.74	1.59	4.36	1386
Cryptocrystallines	23.00	6.04	3.62	.61	1.76	4.98	2662
Quartzite	24.47	6.37	2.73	.69	1.64	4.40	316

NOTES: * Frequency of flake population for which stage was calculated.
a/ Absence of dorsal cortex, 50 percent, 50 percent and 100 percent cortex were assigned values 0, 1, 2, and 3, respectively. Platform was calculated using cortical, single-and multiple-facet platform flakes only assigned values 1, 2, and 3, respectively. Stage was calculated using standardized variables described above.

larger flake size for crystalline volcanic materials. Cryptocrystalline flakes appear to have been produced from cores which were more reduced than those of other material types.

Lowest stage values obtain for glassy volcanic materials, predominantly obsidian, which also average more flakes with cortical platforms and dorsal cortex than do other material types. Owing to the small size of the obsidian nodules from which most of these flakes are produced, glassy volcanic flakes are smallest compared with other materials. Crystalline volcanic cores produce the largest flakes averaging the next highest in dorsal and platform cortex. Cryptocrystalline core materials undergo the most platform modification, ranking highest on the average measure of platform codes. Chert flakes are relatively small and the least cortical of all materials; thus, the average measure of flake stage is highest for cryptocrystallines. Quartzites rank intermediate between cryptocrystallines and crystalline volcanics in size, cortex, platform modification, and stage.

Looking at stage among different flake categories recorded for material types, one can see that measures of flake stage are consistent with the subjectively identified flake categories: undifferentiated, biface thinning, and pressure flake (Table 6.29). Substantially higher measures of stage are obtained for flakes classed as biface reduction and pressure flakes confirming the usefulness of the stage measure. In addition, comparing the ratios of biface reduction flakes to undifferentiated flakes, 0.09 and 0.06 for glassy volcanic and cryptocrystalline materials respectively, and 0.01 and 0.02 for crystalline volcanic and quartzite respectively, the former materials can be seen to be incorporated into the biface reduction process much more frequently than the latter.

Table 6.29. Mean stage of undifferentiated, biface thinning, and pressure flakes for main material types.

Flake Type	GVOL	CVOL	CCS	QZT
All Flakes	4.11	4.36	4.98	4.40
Undiff Flakes	3.97	4.34	4.88	4.36
Bif Red Flakes	5.86	5.72	6.96	6.44
Pres Flakes	5.59	6.39	6.90	6.45

Patterns of flake cortex and size among assemblages— grouped by period and phase indicators as discussed in the previous section are evident in Table 6.30. On the average, Formative Lithic and Late Ceramic flake assemblages contain the smallest flakes and flakes with the lowest average amount of dorsal cortex; these measures contributing to the highest stage measures. Cortex is scaled from 0 (no cortex) to 3 (100 percent dorsal cortex) in Table 6.28. Average dorsal scar count is highest for Unspecific Lithic assemblages. Average platform measures listed in Table 6.30 are not comparable to those previously presented for each period or phase category in that flakes with missing or crushed platforms were not included in the measure.

Because calculation of flake stage for periods and phases is based on flake assemblages which include items deposited during functionally divergent activity episodes and on all material types, it is not surprising that flake stage is not extremely different among assemblages categorized by period and phase. Average flake stage tends to be a lower measure for small flake populations like the Archaic and Early Ceramic assemblages pointing to the need for data from additional artifact associations containing Archaic and Mesilla Phase diagnostic artifacts in order to verify patterns presented here.

Viewing flake stage by material type for spatial associations (Table 6.31), glassy volcanic flake stage is lowest of all material types for all spatial associations, while it is highest for cryptocrystalline flakes for all associations with the exception of the Early Ceramic group. Unspecific Lithic, Formative Lithic, and Late Ceramic groups are characterized by the highest average stage value for cherts which indicate later stage reduction of chert for these associations. Chert flake stage is lowest for associations containing unspecific brownwares and for the Archaic group. Again, the low frequencies of flakes in the Early Ceramic and Archaic groups hampers the comparison. It should be noted, however, that dorsal cortex and scar count attributes for unutilized chert flakes in the West Mesa Archaic assemblage are very similar to those of Keystone Dam Archaic assemblages (cf. O'Laughlin 1980) indicating that the small number of flakes in the West Mesa assemblage does not

Table 6.30. Mean flake attribute values by period and phase. a/

	Len	Thick	DSC	Cortex	Platform	Stage	N*
West Mesa Assemblage	24.69	6.7	3.34	.57	1.68	4.70	4693
Mixed	22.46	6.47	2.91	.77	1.71	4.59	431
Unspecific Lithic	25.30	6.76	3.50	.79	1.69	4.70	2317
Unspecific Ceramic	24.26	6.28	3.18	.76	1.65	4.67	872
Archaic	25.00	7.15	3.00	.62	1.53	4.30	23
Formative Lithic	23.93	6.14	3.19	.45	1.64	4.76	178
Early Ceramic	28.38	7.05	2.96	.69	1.58	4.56	28
Late Ceramic	21.98	5.79	3.08	.57	1.65	4.80	710

NOTES: *Frequency of flake population for which stage was calculated.
a/ Absence of dorsal cortex, 50 percent, 50 percent and 100 percent cortex were assigned values 0, 1, 2, and 3, respectively.
Platform was calculated using cortical, single-and multiple-facet platform flakes only assigned values 1, 2, and 3, respectively.
Stage was calculated using standardized variables described above.

contribute to radical variation from the constellation of attributes that might be expected in regional Archaic assemblages.

Table 6.31. Flake stage by material type for spatial associations grouped on the basis of temporal indicators.

Material Type	GVOL	CVOL	CCS	QZT
Mixed	3.83	4.25	4.94	4.24
Unspecific Lithic	4.24	4.36	5.00	4.27
Unspecific Ceramic	4.14	4.44	4.87	4.65
Archaic	4.19	3.57	4.53	4.41
Formative Lithic	3.68	4.48	5.19	4.07
Early Ceramic	1.94	4.95	4.35	3.08
Late Ceramic	4.17	4.34	5.10	4.75

Bipolar Pebble Reduction

Use of local obsidian nodules, usually less than 6 centimeters in maximum dimension, is not limited to the West Mesa having been noted for the southern Tularosa Basin (Carmichael 1983:189-190). Concerned with production techniques for tool manufacture, Carmichael (1983:189) posits several sequences of obsidian nodule reduction. In one sequence, small thick flakes which have been removed from an anvil-held nodule through bipolar percussion are pressure flaked into small projectile points or used directly. He also proposes the production of split pebbles as described by Cresson (1977) for tool blanks whose steep edges then received retouch. Another sequence produces "orange peel flakes" (Stafford 1977) with a cortical platform encircling half of the flake perimeter serving as a natural backing for flakes used as cutting implements.

Obsidian flakes in the West Mesa assemblage, if not all produced through means of bipolar techniques, certainly exhibit the characteristics expected for products of bipolar pebble reduction (Table 6.32). They are small in comparison to all other material types suggesting their production from local nodules. In addition, they exhibit the highest average dorsal and platform cortex cover and average the least number of dorsal scars.

Table 6.32. Mean attribute measures for obsidian flakes.

Len	Thick	DSC	Cortex	Platform	Stage	N*
17.11	4.37	2.70	.96	1.29	3.910	136

NOTE: *Frequency of complete flakes for which stage was calculated.

Though their average length is considerably shorter compared with that of cherts, quartzites, and volcanic rocks, obsidian flakes were selected for utilization in similar proportions to those of cherts--the ratio of utilized to unutilized flakes being about 0.10 for each material. Thus, bipolar production of flakes for direct use does seem to be one production strategy involving obsidian nodules.

The small number of bipolar cores recorded (12) are predominantly obsidian and represent cores used in the first production sequence proposed by Carmichael, while "tested" nodules from which a single flake had been removed might represent cores on which an "orange peel" production sequence was initiated (Table 6.33). Steeply retouched split pebbles are also present in the assemblage and have been classified as single platform cores.

As previously mentioned, the Archaic and Formative Lithic assemblages contain highest proportions of obsidian flakes, pointing to the possibility that expedient use of local obsidian nodules is associated with, if not the use, then the discard of projectile points. Obsidian cores occur in highest proportions in Formative and Unspecific Lithic assemblages.

Morphology and Use of Cores and Formal Tools

This section assesses the consistency in morphological attributes displayed by unifacial and bifacial core types and compares the occurrence of these types among assemblages classified into period and phase categories.

Table 6.33. Obsidian artifact types in the West Mesa assemblage.

Tested Nodules	16
Undifferentiated Cores	7
Single Platform Cores	13
Multiple Platform Cores	13
Bipolar Cores	8
Bifacial Cores	9
Angular Debris	38
Flakes and Flake Fragments	226
(Undifferentiated flakes	170)
(Undifferentiated flake frags	18)
(Biface reduction flakes	7)
(Pressure flakes	6)
(Bipolar flakes	25)
Bifaces	2
Projectile Points	19
TOTALS	351

Suggestions are made for systematic classification of unifacial cores into categories representing different degrees of core reduction, while subjectively defined bifacial cores are shown to differ in a consistent and expectable manner along a reduction continuum with respect to edge morphology and cortex cover.

Uniface/Biface Morphology

The comparison of core and uniface/biface categories in this section is intended to provide an overview of core and tool morphology and to suggest future methods by which items in these categories might be more consistently documented. The in-field and laboratory analyses of cores and formal tools proceeded in several stages. All items were first coded in the field after which all unifaces and bifaces were collected. Since an analysis of coder consistency for the classification of cores including those items in the Uniface and Biface 1 and 2 categories showed that classification was relatively inconsistent, these items were subsequently inspected and recoded by a single coder in a laboratory setting. Comparisons of the recoded items suggests ways by which a number of attributes might be used to achieve a more consistent classification. Due to limitations on artifact analyses time for this project such a reclassification was not attempted and the problem of inconsistent coding was solved for analysis purposes by including all cores in a single undifferentiated core category.

Unifaces

The results of analysis of coder consistency presented in Chapter 5 show that during in-field analysis some cores and tools in the Uniface 1 or 2 group were classed as single platform and other core types. The inconsistent classification stems in part from definitions of each category which include potentially similar core platform morphologies and from different subjective evaluations of whether a third or more of a face had been flaked. Since the uniface category technically includes single platform cores many of which were utilized, this section will first review the attributes of those collected items classed as unifaces during laboratory analysis. Single platform cores identified during in-field analysis are then compared with items in the uniface category.

The concept of "functional edge" was used to examine collected unifaces. A functional edge as defined by Schutt (1986:6-7) included all edges considered to be usable:

> Functional edges were defined by the overall shape of the tool. For example, measurement on a preform, exhibiting no discrete edges, would be taken around the entire perimeter of the artifact. Measurements on a drill would be taken along both cutting edges of the drill shaft. Both sides of the shaft would be considered on functional edge. When retouch or overall edge morphology indicated that two functional edges were present, several measurements were taken along each functional edge. For example, a bifacial knife with one cutting edge and one backed edge (to facilitate prehension) was considered to have two functional edges.

Up to eight edge angle measurements were made along the perimeter of functional edges; the angle at the intersection of dorsal and ventral faces was measured but not the angle resulting

Table 6.34. Uniface functional edges by angle and material type.

Material Type	Edge Angle 40	50	60	70	80	90	Total No. Edges	No. Unifaces with no functional edges
GVOL	0	0	1	4	1	1	7	6
CVOL	0	0	0	1	0	0	1	18
CCS	1	2	19	31	12	0	65	56

Table 6.35. Uniface functional edges by edge angle and edge modification category.

Modification type	Edge Angle 40	50	60	70	80	90	Total No. Edges	No.Unifaces with no functional edges
None	0	1	5	4	1	1	12	22
Utilization	0	0	2	2	1	0	1	5
Retouch	1	1	14	30	11	0	57	36

from utilization. Mean edge angle and variation in edge angle were used to assess whether edges in a tool class have consistent morphology. Schutt (1986:7) equates low edge angle variability of a tool with completeness, in other words, with all necessary modifications required to prepare a tool for use. It is not the intent of this study to assess tool completeness, however, but rather to compare uniface and biface classes for edge angle and edge sinuousity as measured by variation in the populations of edge angles recorded for each tool class.

More unifaces without functional edges are made from crystalline volcanic materials. Most unifaces with functional edges are manufactured from cryptocrystalline materials with some obsidian unifaces also present in the assemblage (Table 6.34). Uniface functional edge angles range between 60 and 80 degrees. Functional edges were classed as utilized or retouched with most having received retouch -- thus functional edges may be manufactured and not fortuitous although there are a few unretouched unutilized edges that were evaluated as "functional" (Table 6.35). Comparing Uniface types on the basis of functional edge angle, size, (as measured by length) and the amount of cortex present, Type 3 Unifaces appear to have been most consistently recorded (Table 6.36). Edge angle and size differences are not significantly different between Uniface Types 1 and 2, but edge angle and tool length are different between Types 1 and 2 and Type 3 unifaces.

Tables 6.37 and 6.38 compare tool size and amount of cortical cover among core and formal tool types. Uniface types differ on the basis of cortex cover, about 10 percent more items in the Uniface 2 class lack cortex than do items in the Uniface 1 class but this difference is not statistically significant. All Uniface 3's lack cortical covering.

With respect to utilization, a majority of each uniface type exhibits utilization or retouch (Table 6.39). The distinguishing factor between Uniface 1's and 2's is a higher proportion of unmodified items in the Uniface 1 class. Comparing items classed as single platform cores by in-field analysis with Uniface 1's and 2's: Uniface 1's and 2's are each significantly smaller than items classed as cores (Chi= 18.43, p=0.03,d.f=3 for Uniface 1's; Chi= 11.24,

Table 6.36a. Uniface length comparisons.

Type		Mean	Std Dev
Uniface 1	78	43.60	16.43
Uniface 2	48	40.41	14.81
Uniface 3	4	24.00	12.88
Uniface 1 and 2		T= 1.09	n.s.
Uniface 2 and 3		T= 2.14	p =0.036 d.f.= 50

Table 6.36b. Uniface edge angle comparisons.

Type	N	Mean	Std Dev
Uniface 1	125	73.91	11.30
Uniface 2	127	73.79	10.55
Uniface 3	34	65.08	17.39
Uniface 1 and 2		T= 0.0847	n.s.
Uniface 2 and 3		T= 2.7849	p =0.008 d.f.= 159.0

Table 6.37. Core and uniface size classes.

Type	0-3cm	3-6cm	6-10cm	10cm	Totals
SPlat	7.00	54.00	28.00	3.99	54
Uniface 1	20.51	62.82	16.67	0.00	78
Uniface 2	37.50	50.00	12.50	0.00	48
Uniface 3	75.00	25.00	0.00	0.00	4

Table 6.38. Core and formal tool classes by cortex cover (Counts do not include the indeterminate cortex category).

Type	Cortex Cover None	50%	50%	100%	Total
MPlat Core	59	197	71	0	327
SPlat Core	7	25	19	0	51
Uniface 1	26	41	9	0	76
Uniface 2	21	20	6	0	47
Uniface 3	4	0	0	0	4
Biface 1	21	34	3	0	60
Biface 2	25	4	0	0	29
Biface 3	21	0	0	0	21
Projectile Points	57	1	0	0	58

Table 6.39. Single Platform core and Uniface edge modification.

Type	Modification None	Utilization	Retouch
SPlat Core	48	6	3
Uniface 1	26	42	11
Uniface 2	7	26	15
Uniface 3	0	3	1

p=0.01,d.f=3 for Uniface 2's). Single platforms also exhibit significantly more cortical covering than do unifaces (Chi= 14.01, p 0.001, d.f=2 for Uniface 1's; Chi= 14.17, $p < 0.001$, d.f=2 for Uniface 2's)

Edge angle is, thus, not a distinguishing factor for Uniface 1 and 2 Types; this lack of difference may be attributed to flake production technique -- detachment of flakes from a relatively steep angled edge which undergoes refurbishment when the angle becomes too narrow for reliability producing flakes of a certain size. It does appear, however, that core size, amount of cortex cover and presence of utilization could be used as distinguishing attributes to class single platform cores and unifaces into categories which are sensitive to degree of reduction. In general, single platform cores conform to a class of unifacial core which is relatively large with moderate amounts of cortical cover and is unutilized. The Uniface 1, 2, and 3 classes follow a sequence of reduced size and cortex cover and increased incidence of utilization. These variables might be used in the future to more systematically classify unifacial cores by specifying a constellation of attributes which define core classes.

Bifaces

Biface edge angle is between 60 and 70 degrees with biface material types dominated by cherts and including very few quartzite and crystalline volcanic materials (Table 6.40). Comparing Biface types, significant edge angle and size differences were obtained between types 1 and 2 (Table 6.41). Types 2 and 3 are also different in terms of edge angle but not with respect to size. Type 3 bifaces and projectile points are not different in terms of size but again are significantly different in terms of edge angle. Looking only at edge angle then types 1 through projectile points progress from wider to narrow angles in a consistent manner. Type 1 is the largest biface class with Types 2 through 60 remaining similar in size; Types 1 and 2 are significantly different in size (p=.002, Student T-test, d.f. =84.9) but there is no difference in size between Biface 2's and 3's or Biface 3's and projectile points. Decrease in edge sinuousity due to bifacial thinning distinguishes Biface types 2, 3, and projectile points. Subjective analysis of bifaces for the presence of functional edges identified 43 percent of the Biface 1's as lacking functional edges, e.g. edges which were too uneven to be successfully utilized, while 22 percent of the Biface 2's inspected lacked functional edges and only 9 percent of the Biface 3's did. Significant differences exist between Biface types with respect to cortical covering (Table 6.37). Over half of the Biface 1's exhibit some cortex while fewer than 14 percent of the Biface 2's and none of the Biface 3's do.

In summary, large size, steep edge angle, the presence of cortex, and prominent edge sinuousity distinguish the Biface 1 type. Few Biface 2's exhibit cortex and have less sinuous edges. Narrow edge angle, little or no cortex, and even edge retouch distinguish the Biface 3 type. Projectile points complete this continuum with

Table 6.40. Biface functional edges by angle and material type.

Material Type	Edge Angle 40	50	60	70	80	Total No. Edges	No. Bifaces with no functional edges
GVOL	0	3	3	5	0	11	1
CVOL	0	2	2	0	0	4	2
CCS	1	9	20	29	7	66	25
QZT	0	0	0	2	0	2	1

Table 6.41a. Biface length comparisons.

Type	N	Mean	Std Dev
Biface 1	60	42.38	16.58
Biface 2	29	33.72	9.31
Biface 3	21	29.71	18.78
Proj Points	59	30.01	10.37

Table 6.41b. Biface edge angle comparisons.

Type	N	Mean	Std Dev
Biface 1	154	72.34	11.95
Biface 2	138	68.56	12.73
Biface 3	110	64.19	12.70
Proj Point	340	61.32	11.53

Table 6.42. Core and formal tool material types.

TOOL TYPE MATERIAL TYPE

FREQUENCY ROW PCT COL PCT	Glassy Volcn	Crystll Volcn	Cryptocrystall	Quartzite	Sandstone	Other	TOTAL
Unspec Core	8	14	33	1	1	3	60
	13.33	23.33	55.00	1.67	1.67	5.00	
	9.88	9.79	6.27	5.56	14.29	14.29	
Multple Platform	16	83	229	5	5	10	348
	4.60	23.85	65.80	1.44	1.44	2.87	
	19.75	58.04	43.54	27.78	71.43	47.62	
Single Platform	3	15	31	6	0	2	57
	5.26	26.32	54.39	10.53	0.00	3.51	
	3.70	10.49	5.89	33.33	0.00	9.52	
Bipolar Core	9	0	4	0	0	0	13
	69.23	0.00	30.77	0.00	0.00	0.00	
	11.11	0.00	0.76	0.00	0.00	0.00	
Uniface 1	10	12	55	0	0	2	79
	12.66	15.19	69.62	0.00	0.00	2.53	
	12.35	8.39	10.46	0.00	0.00	9.52	
Uniface 2	3	5	38	0	1	1	48
	6.25	10.42	79.17	0.00	2.08	2.08	
	3.70	3.50	7.22	0.00	14.29	4.76	
Uniface 3	0	0	4	0	0	0	4
	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.76	0.00	0.00	0.00	
Biface 1	5	3	47	3	0	2	60
	8.33	5.00	78.33	5.00	0.00	3.33	
	6.17	2.10	8.94	16.67	0.00	9.52	
Biface 2	5	2	21	1	0	0	29
	17.24	6.90	72.41	3.45	0.00	0.00	
	6.17	1.40	3.99	5.56	0.00	0.00	
Biface 3	2	2	17	1	0	0	22
	9.09	9.09	77.27	4.55	0.00	0.00	
	2.47	1.40	3.23	5.56	0.00	0.00	
Proj Pnt	19	5	34	0	0	1	59
	32.20	3.47	57.63	0.00	0.00	1.69	
	23.46	3.50	6.46	0.00	0.00	4.76	
TOTAL	81	143	526	18	7	21	796
	10.18	17.96	66.08	2.26	0.88	2.64	100.00

the narrowest edge angles.

Comparing core and tool material types, bifacial cores (Biface 1's and 2's) are manufactured at a significantly higher rate from cryptocrystalline materials (Table 6.42) than are single and multiple platform cores (chi=13.58, p=.0035 for SPlat cores; chi=24.52, p=.000019 MPlat core) or unifaces (chi=10.452, p=.015). There is no significant difference in material type between Biface 3's and projectile points, but there are relatively few obsidian Biface 1's and 2's. Obsidian projectile points are common, however, suggesting that carrying bifacial blanks for the manufacture of obsidian projectile points is not as common as anticipating biface manufacture with cherts. It is also possible that local nodules are the raw material used in obsidian projectile point manufacture. Obsidian points are relatively short averaging 24.31 millimeters in length compared to an average of 30 millimeters for all points. In addition, the trace element signature of the single projectile point submitted for x-ray fluorescence analysis is the same as that of obsidian nodules which occur in the Rio Grande gravels, both having trace element concentrations identical with the Obsidian Ridge source.

Patterns of Assemblage Content

A flake to core ratio is used here to gauge core abundance in assemblages. Multiple platform cores occur in generally similar proportions in assemblages in all categories which may indicate that these forms represent exhausted and intensively worked items expectable in areas lacking naturally occurring raw materials (Table 6.43). Higher ratios of small to large cores are present in assemblages containing projectile points, another indication that expedient flake production strategies may have been undertaken with recycled materials at the locations of projectile point discard. Bifacial cores occur least frequently in Late Ceramic assemblages. Archaic and Unspecific Lithic assemblages contain lowest flake, single platform core ratio (fewer flakes per core), while Late Ceramic assemblages contain highest flake, single platform core ratio (more flakes per core) of all assemblage categories.

Table 6.43. Flake to core ratios in summed assemblages for periods and phases.

FREQUENCY	FLAKES: UNIFACIAL CORES	FLAKES: MPLAT CORES	FLAKES: BIFACIAL CORES	SMALL:* LARGE CORES
Unspecific Lithic	29.84	22.50	73.55	2.09
Unspecific Ceramic	51.62	24.54	83.06	3.15
Archaic	25.50	25.50	0	5.00
Formative Lithic	55.16	30.09	82.75	5.50
Early Ceramic	21.00	14.00	42.00	2.00
Late Ceramic	79.75	28.36	141.78	1.50

NOTE: *Small cores measure less than 6 centimeters in maximum dimension, and large cores greater than 6 centimeters; all core types and Uniface and Biface 1 and 2 classes are included in this figure.

Projectile Point Descriptions

Plates 6.1 through 6.4 illustrate the morphological range of projectile points recorded on the West Mesa. One basal portion of a Folsom projectile point was collected during the Phase I field inspection of Survey Area 3 (Unit 28), and one collected during the Phase II inventory of survey unit 3SE in Survey Area 3 (Plate 6.1). Each specimen is fluted on both faces. The specimen from Unit 28 exhibits heavy basal grinding along its lateral edges, and is crazed from exposure to heat. The Folsom point collected from Unit 3SE retains portions of a nipple-shaped striking platform at the center of its base used for removal of a channel flake. No basal grinding is evident on this specimen. A finely flake projectile point midsection with unidirectional marginal retouch along a diagonal fracture was also collected from survey Unit 110 (Plate 6.1). The fine collateral flaking on this point is similar to that of Paleoindian projectile points of the Cody Complex.

Large stemmed, side-notched and corner-notched points include San Jose, Chiricahua, San Pedro, Augustin, Jay, and Datil forms (Haury 1950; Dick 1965; Irwin-Williams 1973; Windmiller 1973) which may be Archaic origin (Plates 6.1 and 6.2). Examples of each projectile point form include single or few specimens. Table 6.44 lists complete and nearly complete West Mesa projectile points and figure numbers of illustrated points. Small corner-notched forms include the small varieties of Chiricahua and San Pedro points. Small asymmetrical forms with irregularly serrated edges, stemmed, and corner-notched traingular forms may be of later Puebloan origin (Plate 6.3). Archaic-like projectile point forms occur unassociated with other later point forms or ceramics in 9 spatial associations while other point forms of presumably later origin occur in 34 aceramic associations.

A variety of breakage patterns characterize West Mesa projectile points. Approximately half of the inventoried points are complete, while a majority of the remainder includes nearly complete forms with snapped or crushed tips (listed together as snapped) and damaged basal portions (Table 6.45). No one general material type appears to exhibit more of one breakage pattern than another.

Groundstone Artifacts

Approximately 20 percent of all lithic artifacts recorded by the Phase II survey are groundstone tools and debris. A majority of the inventoried groundstone is made up of indeterminate-type tool fragments (Table 6.46), but even of the defined groundstone types recorded, only 11 percent were judged to be complete (Table 6.47). The use-wear on many of these complete tools indicates intensive tool reuse as does the fact that over one third of the groundstone recorded shows evidence of being recycled as hearth rock. These patterns are pursued below with comparisons of artifact type, material type, and evidence of fire-alteration on artifacts.

The attributes of complete and nearly complete groundstone artifacts are listed in Table 6.48. The fact that so few manos and metates could be classified as complete is one line of evidence for an intensive use and reuse of groundstone.

Only a single metate was originally recorded as a complete artifact (Item 21NW-894), several other metates qualify as complete-but-recycled artifacts. These include a quartzite metate fragment (45SE-3404); the original grinding surface of which had been truncated and the opposing face used as a complete grinding surface. Another slab metate (1-561), the long axis of which had been halved had been reused so that the direction of grinding on the broken artifact is perpendicular to the one on the originally used surface.

An only slightly higher proportion of complete manos was recorded. In this group are a number of highly eroded, ovate- and wedge-shaped sandstone specimens which exhibit questionable grinding surfaces. Since sandstone does not occur naturally on the West Mesa, these items have been included in the mano category as highly eroded specimens, and attributes of their grinding surfaces have been coded as indeterminate; they are not listed in Table 6.48. Of the other complete or nearly complete specimens listed, approximately 60 percent exhibit evidence of heavy use. These forms include bifacial wedges and multifacial pyramidal forms like those illustrated by Carmichael (1983:Figure 31) as manos from the Tularosa Basin which show the most advanced stages of use. Unlike the distribution of mano material types in the Tularosa Basin, however, sandstone, rather than granitic rock is the most commonly used raw material on the West Mesa.

Use-wear and Fire-alteration

Carmichael (1983:191) suggests that sandstone manos may be cycled through a reduction sequence differently from granitic manos possibly because granitic manos leave the sequence earlier due to their preferred use as hearth rock. A greater proportion of sandstone manos from the Tularosa Basin in heavy use categories is attributed to this possibility. Other factors cited for the pattern of intensively used sandstone manos are the differential hardness of raw materials, sandstone being softer and therefore more readily worn.

Table 6.44. Complete and nearly complete projectile points.

UNIT	ITEM	GRID	MATERIAL	LENGTH	WIDTH	THICKNESS	COMMENT
1	525		chert	40	18	5	Plate 6.3e
110	1122		chert	30	20	4	Plate 6.2i
110	231		cryst volc	49	17	7	Plate 6.3h
3 SE	1259		chert	25	16	5	reworked
3 SE	1972		obsidian	32	27	4	Plate 6.1g
2 SE	38		cryst volc	29	12	6	
2 SE	554		chert	37	16	7	Plate 6.3j
3 SE	8000		chert	36	24	4	Plate 6.4b
3 NW	880		chert	47	17	7	
3 NW	969		obsidian	27	15	4	Plate 6.2h
21 SW	118		chert	52	20	7	Plate 6.1j
21 SW	72		obsidian	24	16	4	Plate 6.3a
21 NW	1444		chert	31	17	3	Plate 6.2g
21 SE	789		chert	32	18	8	Plate 6.2e
25	2		obsidian	28	18	7	Plate 6.2a
32	605		chert	42	15	8	Plate 6.3f
32	382		obsidian	35	21	6	Plate 6.3k
32	153		obsidian	23	17	4	Plate 6.2j
45 NW	126		chert	40	18	5	Plate 6.2d
45 NE	363		chert	29	14	4	Plate 6.3d
45 SE	1196		obsidian	16	11	4	
45 SE	1275		cryst volc	25	19	6	
45 SE	181		obsidian	26	15	5	
45 SE	2911		chert	28	16	4	Plate 6.3b
48 NW	73		chert	33	20	4	Plate 6.3g
50	1774		obsidian	23	17	4	reworked on base, Plate 6.1i
50	2117		chert	37	22	5	Plate 6.2c
50	436		chert	51	21	5	Plate 6.4a
50	1784		obsidian	18	16	3	Plate 6.4c
50	2150		chert	12	10	3	Plate 6.4e
75	1470		chert	60	32	4	snapped tip, base broken
75	3310		obsidian	25	14	5	Plate 6.2f
75	400		chert	22	18	4	Plate 6.2b
3 NW		10-9Q	obsidian	22	9	4	
3 NE		10-3B	chert	31	16	6	Plate 6.1h

Table 6.45. Material type and breakage patterns of projectile points.

Portion Frequency Expected	Material Type obsidian	cryst. volcanic	chert	other	TOTAL PERCENT
base	1 2.3	0 0.6	6 4.0	0 0.1	7 0.12
whole, base broken	2 2.3	2 0.6	3 4.0	0 0.1	7 0.12
reworked base	1 0.6	0 0.2	1 1.2	0 0.0	2 0.03
whole, tip & base snapped	1 1.3	0 0.3	3 2.3	0 0.1	4 0.07
tip/ midsection	2 1.3	0 0.3	1 2.3	1 0.1	4 0.07
whole, tip snapped	2 2.3	1 0.6	4 4.0	0 0.1	7 0.12
whole	10 9.0	2 2.4	16 16.1	0 0.5	28 0.47
TOTAL PERCENT	19 0.32	5 0.08	34 0.58	1 0.02	59

Table 6.46. Groundstone tool and material types.

Groundstone Type Frequency Percent	Material Type sand stone	 crystal. volcanic	 quartzite	 other	Total
metate	303	154	208	32	697
	9.71	4.93	6.66	1.02	22.33
worked slab	4	5	3	0	12
	0.13	0.16	0.10	0.00	0.38
mano	295	78	46	31	450
	9.45	2.50	1.47	0.99	14.41
mano/grinding slab	32	4	2	0	38
	1.02	0.13	0.06	0.00	1.22
hammerstone	3	233	35	53	324
	0.10	7.46	1.12	1.70	10.38
other	10	7	6	3	26
	0.32	0.22	0.19	0.10	0.83
indetermin. fragment	510	345	618	102	1575
	16.34	11.05	19.80	3.27	50.45
Total	1157	826	918	221	3122
	37.06	26.46	29.40	7.08	100.00

Frequency Missing = 2

Table 6.47. Groundstone types by completeness.

Groundstone Type	Completeness			
Frequency Percent	<1/2	>1/2	whole	Total
metate	690	7	1	698
	22.09	0.22	0.03	22.35
worked slab	11	0	1	12
	0.35	0.00	0.03	0.38
mano	368	54	28	450
	11.78	1.73	0.90	14.41
mano/grinding slab	35	2	1	38
	1.12	0.06	0.03	1.22
hammerstone	176	27	121	324
	5.64	0.86	3.87	10.37
other	9	1	16	26
	0.29	0.03	0.51	0.83
indetermin. fragment	1565	10	0	1575
	50.11	0.32	0.00	50.43
Total	2854	101	179	3123
	91.38	3.23	5.38	100.00

Frequency Missing = 1

Table 6.48. Attributes of complete and nearly complete groundstone artifacts.

Unit	Item	Type	Material	Length (mm)	Width (mm)	Thickness (mm)	Form	Comments
3NE	1513	PESTLE	limestone	340	67	46	rectangular	Unifacial marginal retouch on one striated surface
3NE	266	OVATE HANDSTONE	quartzite	115	102	35	bifacial wedge	
3NE	304	OVATE HANDSTONE	qrzt ss*	70	70	22	bifacial biconvex	
3NW	831	UNDIFF MANO	sandstone	125	120	50	unifacial	
3NW	8-1B	OVATE HANDSTONE	sandstone	100	50	28	unifacial convex	
3NW	8-2B	OVATE HANDSTONE	crys vol**	95	60	29	multifacial	
21NW	894	SLAB METATE	sandstone	370	233	32	bifacial biconcave	
21NW	1902	OVATE HANDSTONE	qrzt ss	100	100	25	unifacial	
21NW	2010	SUBREC HANDSTONE	qrzt ss	98	85	20	unifacial?	one surface truncated
21SE	949	OVATE HANDSTONE	qrzt ss	110	89	24	bifacial biconvex	
32	97	UNDIFF MANO	andesite	115	102	70	unifacial	irregular cobble
45NE	431	OVATE HANDSTONE	sandstone	85	70	29	bifacial wedge	
45NE	583	SUBREC HANDSTONE	andesite	118	110	32	bifacial plano convex	
45NE	71	GROUND COBBLE	sandstone	113	63	75	unifacial	
45SE	1054	HANDSTONE/GR SURFACE	granite	88	55	35	bifacial plano concave fire-altered	
45SE	1113	OVATE HANDSTONE	qrzt ss	102	87	46	bifacial wedge	
45SE	686	GRINDING PEBBLE	rhyolite	59	51	30	unifacial	
45SE	4086	OVATE HANDSTONE	sandstone	80	86	42	unifacial	
45SE	3411	OVATE HANDSTONE	qrzt ss	79	64	27	multifacial wedge	
45SE	3404	SLAB METATE	quartzite	260	145	32	bifacial	complete grinding surface on one side truncated grinding surface on the other
45SW	203	OVATE HANDSTONE	sandstone	111+	80	41	unifacial	
45SW	520	UNDIFF MANO	granite	92	85	35	bifacial wedge	
48NW	145	OVATE HANDSTONE	sandstone	80+	82	38	bifacial biplano	
48NW	189	OVATE HANDSTONE	granite	78	73	38	bifacial biplano	
48NW	183	OVATE HANDSTONE	scoria	70	55	38	unifacial	
1	560	SUBREC HANDSTONE	qrzt ss	154	106	40	bifacial plano convex	
1	561	SLAB METATE	andesite	280	150	38	unifacial	original grinding surface broken in half reused in direction perpendicular to to original surface
50	787	UNIDIFF MANO	scoria	117	79	57	unifacial	highly eroded
110	230	SUBREC HANDSTONE	qrzt ss	125	113	60	bifacial biconvex	
75	1314	UNDIFF MANO	qrzt ss	125	104	30+	unifacial	
21NW	713	UNDIFF MANO	qrzt ss	68	48	23	multifacet pyramidal	

NOTES: *quartzitic sandstone
**unidentified crystalline volcanic

In order to pursue this pattern with the West Mesa groundstone data, the degree of use-wear on groundstone recorded on the West Mesa was classified by grouping items with one, two, and more than two ground surfaces into unifacial, bifacial, and multifacial categories, respectively. The problem with this approach is that since most items are fragmentary, the size of the artifact may dictate the number of ground surfaces on the item, obscuring any relationship between material type and degree of use. Comparisons of use-wear and material type were therefore made between (1) groundstone in only the two largest recorded size categories, 6-10 centimeters and greater than 10 centimeters in maximum dimension, and (2) all groundstone in mano, metate, and indeterminate fragment categories in order to determine if including small-sized artifacts in the examined sample biases use-wear categories represented toward items with fewer ground surfaces.

Comparing mano use-wear categories (Table 6.49a.), slightly higher proportions of unifacial items occur when all sizes of artifacts, rather than only the larger artifacts, are considered but no significant differences (alpha=0.01) were found in the proportions of items in unifacial, bifacial, and multifacial categories between a sample of all size classes and the sample which includes only the larger size classes of artifacts. A similar result was found with metate fragments. These findings justify using all size classes of mano and metate fragments, whether complete or fragmentary, in tests for differential use-wear between material types.

Sandstone is the most frequently used material type for manos with lesser amounts of volcanic rock and quartzite used. Most manos are fragmentary (about 94 percent, see Table 6.47) and exhibit single ground surfaces. Considering sandstone, quartzite, and volcanic rocks, most fragments classed as unifacial are quartzite and most multifacial fragments are sandstone. Comparing the degree of use-wear on all fragmentary and complete manos among material types (Table 6.49a), however, no one use-wear or material type category includes significantly more manos than expected.

Looking at metate fragments in all size classes (Table 6.49b), although sandstone is still the most prevalent material type, slightly greater than expected numbers of volcanic rock metates occur in the bifacial category and fewer in the unifacial category. Slightly more sandstone fragments than expected occur in the multifacial category. There is again, however, no statistically significant difference ($\underline{p}= 0.01$) between volcanic and sandstone material types in the numbers of metate fragments in each use-wear category.

To summarize, considering all size classes of manos and metate fragments, sandstone fragments are slightly more frequent than expected in the multifacial category, and quartzite fragments more frequent in the unifacial category. Volcanic rocks exhibit slightly more bifacial and unifacial fragments than expected. These differences are, however, not statistically different from expected values. Comparing mano and metate use-wear categories among material types, it appears then that no one material was used to a greater extent than another.

Unlike mano and metate fragments, fragments of indeterminate type in smaller size classes are more likely to have only one ground surface. Significantly greater proportions of unifacial fragments were found to exist in the sample of all size classes than in the sample of fragments greater than or equal to 6 centimeters in maximum dimension for each material type (Chi-square, $\underline{p} < 0.0001$). This is particularly true for quartzite (Table 6.49c), but probably does not relate to the fact that quartzite was selected for use as unifacial metates or manos in greater abundance than volcanic rock. A more likely explanation may be that recycling quartzitic groundstone as hearth rock produces more small unifacial fragments than does recycling other material types.

Table 6.50 indicates that the groundstone material type which has the highest proportions of items that show heat alteration is quartzite. This may not be because quartzite was selected for its heat retention properties over other materials but simply because it is more friable. The size distributions of all groundstone artifacts as they relate to fire alteration is presented in Table 6.51. Quartzite is distinguished by significantly higher frequencies of items in the smallest size class then are sandstone and volcanic rock ($\underline{p} > 0.0001$, Chi-square=201 for sandstone and $p > 0.0001$,

BLANK

PAGE

Table 6.49a. Mano use-wear versus material type.

ALL ITEMS

Use-wear Category	Material Type				
Frequency Expected Percent Row Pct Col Pct	cryst volc	quart-zite	other	sand-stone	Total
unif mano	36	25	22	148	231
	39.3	23.8	16.0	151.9	
	8.05	5.59	4.92	33.11	51.68
	15.58	10.82	9.52	64.07	
	47.37	54.35	70.97	50.34	
bifac mano	35	19	8	122	184
	31.3	18.9	12.8	121.0	
	7.83	4.25	1.79	27.29	41.16
	19.02	10.33	4.35	66.30	
	46.05	41.30	25.81	41.50	
multif mano	5	2	1	24	32
	5.4	3.3	2.2	21.0	
	1.12	0.45	0.22	5.37	7.16
	15.63	6.25	3.13	75.00	
	6.58	4.35	3.23	8.16	
Total	76	46	31	294	447
	17.00	10.29	6.94	65.77	100.00

Statistic	DF	Value	Prob
Chi-Square	6	6.524	0.367

LARGE SIZE CLASSES ONLY

Use-wear Category	Material Type				
Frequency Expected Percent Row Pct Col Pct	cryst volc	quart-zite	other	sand-stone	Total
unif mano	13	7	10	60	90
	14.7	7.1	5.9	62.4	
	6.05	3.26	4.65	27.91	41.86
	14.44	7.78	11.11	66.67	
	37.14	41.18	71.43	40.27	
bifac mano	19	10	3	71	103
	16.8	8.1	6.7	71.4	
	8.84	4.65	1.40	33.02	47.91
	18.45	9.71	2.91	68.93	
	54.29	58.82	21.43	47.65	
multif mano	3	0	1	18	22
	3.6	1.7	1.4	15.2	
	1.40	0.00	0.47	8.37	10.23
	13.64	0.00	4.55	81.82	
	8.57	0.00	7.14	12.08	
Total	35	17	14	149	215
	16.28	7.91	6.51	69.30	100.00

Statistic	DF	Value	Prob
Chi-Square	6	8.435	0.208

Table 6.49b. Metate use-wear versus material type.

ALL ITEMS

Use-wear Category Frequency Expected Percent Row Pct Col Pct	Material Type cryst volc	quartzite	other	sandstone	Total
unif metate	112	169	22	230	533
	117.8	159.1	24.5	231.7	
	16.07	24.25	3.16	33.00	76.47
	21.01	31.71	4.13	43.15	
	72.73	81.25	68.75	75.91	
bifac metat	39	34	6	59	138
	30.5	41.2	6.3	60.0	
	5.60	4.88	0.86	8.46	19.80
	28.26	24.64	4.35	42.75	
	25.32	16.35	18.75	19.47	
multif meta	3	5	4	14	26
	5.7	7.8	1.2	11.3	
	0.43	0.72	0.57	2.01	3.73
	11.54	19.23	15.38	53.85	
	1.95	2.40	12.50	4.62	
Total	154	208	32	303	697
	22.09	29.84	4.59	43.47	100.00

Statistic	DF	Value	Prob
Chi-Square	6	14.361	0.026

LARGE SIZE CLASSES ONLY

Use-wear Category Frequency Expected Percent Row Pct Col Pct	Material Type cryst volc	quartzite	other	sandstone	Total
unif metate	53	44	12	125	234
	54.7	44.5	12.4	122.5	
	16.51	13.71	3.74	38.94	72.90
	22.65	18.80	5.13	53.42	
	70.67	72.13	70.59	74.40	
bifac metat	20	13	3	35	71
	16.6	13.5	3.8	37.2	
	6.23	4.05	0.93	10.90	22.12
	28.17	18.31	4.23	49.30	
	26.67	21.31	17.65	20.83	
multif meta	2	4	2	8	16
	3.7	3.0	0.8	8.4	
	0.62	1.25	0.62	2.49	4.98
	12.50	25.00	12.50	50.00	
	2.67	6.56	11.76	4.76	
Total	75	61	17	168	321
	23.36	19.00	5.30	52.34	100.00

Statistic	DF	Value	Prob
Chi-Square	6	3.815	0.702

Table 6.49c. Groundstone fragment use-wear versus material type.

```
Use-wear Category          Material Type

Frequency
Expected
 Percent
 Row Pct
 Col Pct           cryst  quart-   sand-
                    volc    zite   stone     other    Total
------------+--------+--------+--------+--------+
unif metate     306      574      403       89     1372
              300.5    538.3    444.3     88.9
              19.43    36.44    25.59     5.65    87.11
              22.30    41.84    29.37     6.49
              88.70    92.88    79.02    87.25
------------+--------+--------+--------+--------+
bifac metat      33       21       78       10      142
               31.1     55.7     46.0      9.2
               2.10     1.33     4.95     0.63     9.02
              23.24    14.79    54.93     7.04
               9.57     3.40    15.29     9.80
------------+--------+--------+--------+--------+
multif meta       6       23       29        3       61
               13.4     23.9     19.8      4.0
               0.38     1.46     1.84     0.19     3.87
               9.84    37.70    47.54     4.92
------------+--------+--------+--------+--------+
               1.74     3.72     5.69     2.94

Total           345      618      510      102     1575
              21.90    39.24    32.38     6.48   100.00

 Statistic                     DF     Value       Prob
 -----------------------------------------------------
 Chi-Square                     6    59.060      0.000
```

```
Use-wear Category          Material Type

Frequency
Expected
 Percent
 Row Pct
 Col Pct           cryst   quart-            sand-
                    volc     zite    other   stone     Total
------------+--------+--------+--------+--------+
unif metate      13        7       10       60       90
               14.7      7.1      5.9     62.4
               6.05     3.26     4.65    27.91    41.86
              14.44     7.78    11.11    66.67
              37.14    41.18    71.43    40.27
------------+--------+--------+--------+--------+
bifac metat      19       10        3       71      103
               16.8      8.1      6.7     71.4
               8.84     4.65     1.40    33.02    47.91
              18.45     9.71     2.91    68.93
              54.29    58.82    21.43    47.65
------------+--------+--------+--------+--------+
multif meta       3        0        1       18       22
                3.6      1.7      1.4     15.2
               1.40     0.00     0.47     8.37    10.23
              13.64     0.00     4.55    81.82
------------+--------+--------+--------+--------+
               8.57     0.00     7.14    12.08

Total            35       17       14      149      215
              16.28     7.91     6.51    69.30   100.00

 Statistic                     DF     Value       Prob
 -----------------------------------------------------
 Chi-Square                     6     8.435      0.208
```

Table 6.50. Fire-alteration on groundstone material types and items sorted by completeness.

```
Material Type      FAR

Frequency
 Percent
 Row Pct
 Col Pct     altered  not-alt     Total
-----------+--------+--------+
          .        0        2        2
                0.00     0.06     0.06
                0.00   100.00
                0.00     0.10
-----------+--------+--------+
cryst volc       260      566      826
                8.33    18.14    26.47
               31.48    68.52
               24.10    27.72
-----------+--------+--------+
 quartzite       431      487      918
               13.81    15.60    29.41
               46.95    53.05
               39.94    23.85
-----------+--------+--------+
     other        36      182      218
                1.15     5.83     6.98
               16.51    83.49
                3.34     8.91
-----------+--------+--------+
 sandstone       352      805     1157
               11.28    25.79    37.07
               30.42    69.58
               32.62    39.42
-----------+--------+--------+
Total           1079     2042     3121
               34.57    65.43   100.00
```

```
     COMPLETE        FAR

Frequency
 Percent
 Row Pct
 Col Pct          altered  not-alt     Total
--------------+--------+--------+
indeterm frag      1055     1787      2842
                  33.80    57.26     91.06
                  37.12    62.88
                  97.78    87.51
--------------+--------+--------+
          >1/2       14       87       101
                   0.45     2.79      3.24
                  13.86    86.14
                   1.30     4.26
--------------+--------+--------+
         whole       10      168       178
                   0.32     5.38      5.70
                   5.62    94.38
                   0.93     8.23
--------------+--------+--------+
Total              1079     2042      3121
                  34.57    65.43    100.00
```

BLANK

PAGE

Table 6.51. Size class versus fire-alteration for all groundstone.

QUARTZITE

SIZE	FAR		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
0-3cm	162	168	330
	156.0	174.0	
	17.76	18.42	36.18
	49.09	50.91	
	37.59	34.93	
3-6cm	238	208	446
	210.8	235.2	
	26.10	22.81	48.90
	53.36	46.64	
	55.22	43.24	
6-10cm	30	83	113
	53.4	59.6	
	3.29	9.10	12.39
	26.55	73.45	
	6.96	17.26	
>10cm	1	22	23
	10.9	12.1	
	0.11	2.41	2.52
	4.35	95.65	
	0.23	4.57	
Total	431	481	912
	47.26	52.74	100.00

SANDSTONE

SIZE	FAR		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
0-3cm	23	143	166
	50.7	115.3	
	1.99	12.40	14.40
	13.86	86.14	
	6.53	17.85	
3-6cm	191	343	534
	163.0	371.0	
	16.57	29.75	46.31
	35.77	64.23	
	54.26	42.82	
6-10cm	118	244	362
	110.5	251.5	
	10.23	21.16	31.40
	32.60	67.40	
	33.52	30.46	
>10cm	20	71	91
	27.8	63.2	
	1.73	6.16	7.89
	21.98	78.02	
	5.68	8.86	
Total	352	801	1153
	30.53	69.47	100.00

VOLCANIC ROCK

SIZE	FAR		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
0-3cm	32	78	110
	34.8	75.2	
	3.91	9.52	13.43
	29.09	70.91	
	12.36	13.93	
3-6cm	158	249	407
	128.7	278.3	
	19.29	30.40	49.69
	38.82	61.18	
	61.00	44.46	
6-10cm	64	204	268
	84.8	183.2	
	7.81	24.91	32.72
	23.88	76.12	
	24.71	36.43	
>10cm	5	29	34
	10.8	23.2	
	0.61	3.54	4.15
	14.71	85.29	
	1.93	5.18	
Total	259	560	819
	31.62	68.38	100.00

Chi-square=172.4 for volcanic rocks, d.f.=3). Comparing only items which show evidence of fire-alteration, quartzite fragments are again much smaller than sandstone fragments ($p > 0.0001$, Chi-square= 151.8) and volcanic rock fragments ($p > 0.001$, Chi-square=75.26, d.f.=3). There are also more small, fire-altered volcanic rock fragments than there are sandstone fragments ($p > 0.006$, Chi-square= 15.82, d.f.=3).

From these results, it appears that quartzite may be more friable than other material types whether or not it is fire-altered. Quartzite may also not exhibit evidence of alteration even though it has been subject to heat resulting in the classification of many small fragments as unaltered that have actually been used as hearth rock. Given the abundance of small fragments in the altered quartzite assemblage, even though quartzite frequencies are the highest, the volume of fire-altered quartzite used may be equivalent to that of other materials. As sandstone is more abundant in the larger size classes than is quartzite, the actual volume of sandstone used as hearth rock is probably greater.

Larger artifacts make up 40 percent of the fire-altered sandstone recorded and 27 percent of the altered volcanic rock. With regard to these material types, fewer small sandstone fragments have been subject to alteration than have small volcanic rock fragments. Although a higher proportion of volcanic rock may have been used as hearth rock, the overall frequency and volume of sandstone items recycled into hearths is still greater.

Comparing the degree of use-wear on groundstone artifacts with whether or not items show evidence of fire-alteration, it appears that items in all stages of reduction are cycled into hearths (Table 6.52). Generally, similar proportions of mano and metate fragments in different use-wear categories are subject to heat alteration as are indeterminate-type groundstone fragments. The exception may be multifacial manos which show evidence of fire-alteration in much lower proportions than do other mano or metate use-wear categories; but low frequencies of this artifact class may be conditioning the pattern. Higher proportions of indeterminate-type fragments have been subject to heat alteration than of mano or metate fragments, as might be expected, since recycling artifacts as hearth rock can cause rock to fragment precluding identification of artifact type.

In conclusion, the West Mesa groundstone data do not indicate strong evidence for the more intensive use of sandstone than of volcanic rock. Comparisons among material types for differential use-wear, indicate no strong differences in the degree of use-wear on mano and metate fragment among material types. Looking at artifact size class as an indication of the degree of artifact fragmentation, quartzite is more highly fragmented, perhaps because of the qualities of the stone itself, than are other material types. Overall higher frequencies of volcanic rock than of sandstone do appear to have been used as hearth rock, but a greater volume of the latter as indicated by the distribution of items among sizes classes was used in hearths.

All artifact types regardless of their degree of use-wear have been recycled as hearth rock. Burned rock features which contain recycled groundstone also invariably contain burned caliche, but the reverse is not true. Some burned rock features containing high frequencies of fire-altered caliche do not contain any other rock types, although these are present in the general vicinity. An activity specific dichotomy, as proposed by O'Laughlin (1979:69), between hearths containing burned caliche and those containing other rock types is not suggested by the contents of West Mesa hearths since rock types are often mixed within a single feature.

Nor does the differential material type contents of hearths necessarily suggest that distance from rock sources dictate the rock types that will be used as suggested by Carmichael (1983:201) for hearth rock in the Tularosa Basin, since both caliche and discarded groundstone can be considered to be "locally" available materials. It may be, rather, that anticipation of activities dictates whether or not groundstone artifacts will be scavenged for use as hearth rock. Activities in the inner desert basin may be anticipated with the prior procurement of quarried caliche. In the absence of planned procurement of hearth rock, immediately available discarded groundstone artifacts as well as previously used caliche might be gathered up and recycled as hearth rock. Different strategies for provisioning one's self with hearth rock

BLANK

PAGE

Table 6.52. Degree of use-wear versus fire-alteration on metates, manos, and indeterminate fragments.

METATES

	Use-wear Category		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
bifac metat	35	103	138
	46.3	91.7	
	5.01	14.76	19.77
	25.36	74.64	
	14.96	22.20	
multif meta	9	17	26
	8.7	17.3	
	1.29	2.44	3.72
	34.62	65.38	
	3.85	3.66	
unif metate	190	344	534
	179.0	355.0	
	27.22	49.28	76.50
	35.58	64.42	
	81.20	74.14	
Total	234	464	698
	33.52	66.48	100.00

MANOS

	Use-wear Category		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
bifac man	50	134	184
	53.1	130.9	
	11.19	29.98	41.16
	27.17	72.83	
	38.76	42.14	
multif ma	4	28	32
	9.2	22.8	
	0.89	6.26	7.16
	12.50	87.50	
	3.10	8.81	
unif mano	75	156	231
	66.7	164.3	
	16.78	34.90	51.68
	32.47	67.53	
	58.14	49.06	
Total	129	318	447
	28.86	71.14	100.00

FRAGMENTS

	Use-wear Category		
Frequency Expected Percent Row Pct Col Pct	altered	not-alt	Total
bifac fra	53	89	142
	59.3	82.7	
	3.37	5.65	9.02
	37.32	62.68	
	8.05	9.71	
multif fr	24	37	61
	25.5	35.5	
	1.52	2.35	3.87
	39.34	60.66	
	3.65	4.03	
unif frag	581	791	1372
	573.2	798.8	
	36.89	50.22	87.11
	42.35	57.65	
	88.30	86.26	
Total	658	917	1575
	41.78	58.22	100.00

rather than the differential function of hearths may, thus, be indicated by variation in hearth rock material types.

Groundstone in Cultural Periods and Phases

Spatial associations of artifacts described in Chapter 3 are examined in this section for groundstone content. Spatial associations can be thought of as relatively small spatial clusters of artifacts and features which if classified through conventional techniques on the basis of temporally diagnostic artifacts fall into six groups. These are Early, Late, and Unspecific Ceramic groups and Archaic, Formative Lithic, and Unspecific Lithic groups (mixed assemblages are not included here).

Table 6.53 lists groundstone tool and material type percentages for summed assemblages in each group. Although technically most hammerstone types do not exhibit ground surfaces, hammerstones are included in this table rather than with the chipped stone assemblage since hammerstones are not manufactured by means of percussion or pressure flaking as are flakes and facially retouched implements. Tool type proportions are roughly similar among groups, although Archaic and Formative Lithic groups are distinguished by lower proportions of metate fragments and moderately high proportions of hammerstones and hammerstone fragments. The Archaic, Formative, and Unspecific Lithic groups contain highest proportions of indeterminate-type groundstone fragments suggesting more intensive groundstone recycling at these locations.

These patterns are reflected in material type proportions in each assemblage (Table 6.54). High proportions of crystalline volcanic rocks in Archaic and Formative Lithic assemblages may be due to the relative abundance of hammerstones in assemblages compared with mano and metate fragments. The low proportions of quartzite in the Archaic assemblage can be attributed to a low incidence of metates as the most common use for quartzite is the manufacture of metates (see Table 6.53). Highest proportions of sandstone occur in the Archaic, Early, and Late Ceramic assemblages, but appear to be distributed among mano, metate, and indeterminate fragment types rather than a single artifact type.

Looking at the distribution of tool and material types together in each assemblage (Table 6.55), highest percentages of sandstone metates occur in Early and Late Ceramic assemblages and lowest in assemblages associated with projectile points, while sandstone manos are most prevalent in Late Ceramic and Formative Lithic assemblages. Relatively more abundant sandstone in later groundstone assemblages reinforces Eidenbach's (1980) suggestion that the abundance of sandstone in the later prehistoric sequence may indicate the relative importance of maize processing. Sandstone does make up half of the Archaic groundstone assemblage as well but a high proportion of sandstone in this assemblage may be attributable to the overall low frequency of artifacts in this assemblage. Volcanic rock hammerstones occur in high proportions in Archaic, Early Ceramic, and Formative Lithic assemblages.

Patterning in groundstone material type proportions in each temporal group can be compared with proportions of different material types recycled into hearth rock. Archaic and Formative Lithic assemblages have uniformly high percentages of FAR in material type categories other than caliche (Table 6.56). Early Ceramic associations also contain high proportions of sandstone FAR.

The relationships between sandstone and volcanic rock groundstone and FAR are illustrated in Figures 6.1 and 6.2. As might be expected of expediently recycled materials, a positive relationship exists between the proportions of groundstone and FAR in each material type. A correlation coefficient of 0.78 (Pearson's r, p=0.06,d.f.=4) was obtained for proportions of volcanic rock in groundstone and FAR assemblages and of 0.79 (p=0.06, d.f.=4) for proportions of sandstone groundstone and FAR indicating that volcanic and sandstone groundstone is probably recycled in relation to its abundance in the cultural environment and that preferential selection of some materials over others for cycling into hearths probably did not exist.

These figures also indicate which associations contain highest proportions of each material type in groundstone and FAR assemblages. Again, volcanic groundstone is most abundant in Archaic and Formative Lithic assemblages as is volcanic FAR. Sandstone groundstone makes up a higher

BLANK

PAGE

Table 6.53. Groundstone material types by temporal categories.

Associations	Material Types			
	Crystalline Volcanics	Quartzite	Cryptocrystallines	Sandstone
Ceramic				
Early Ceramic	24.14	17.24	3.45	48.28
Late Ceramic	21.39	26.47	4.28	43.05
Unspecific Ceramic	24.86	35.70	2.62	33.64
Lithic				
Archaic	34.62	3.85	0	50.00
Formative Lithic	36.45	18.69	5.61	29.91
Unspecific Lithic	27.04	29.41	4.02	36.69

Table 6.54. Groundstone tool types by temporal categories.

Associations	Tool types					
	Metate	Worked Slab	Mano/ Grinding Slab	Mano	Hammerstone	Indeterminate Fragment
Ceramic						
Early Ceramic	27.59	0	0	34.48	13.79	24.14
Late Ceramic	21.39	0	1.07	15.78	12.83	48.93
Unspecific Ceramic	24.49	.56	1.68	12.52	10.47	50.28
Lithic						
Archaic	15.38	0	0	11.54	15.38	57.69
Formative Lithic	17.76	.93	1.87	14.02	13.08	55.34
Unspecific Lithic	22.59	.47	1.24	13.84	8.99	52.57

Table 6.55. Groundstone tool and material type percentages in temporal groups.

		ARCHAIC	EARLY CERAMIC	LATE CERAMIC	FORMATIVE LITHIC	UNSPECIFIC LITHIC	UNSPECIFIC CERAMIC
METATES	CVOL	3.85	3.45	3.21	2.80	5.33	4.11
	QZT	0	6.90	2.94	9.35	7.40	8.60
	CCS	0	0	.53	0	.41	.56
	SED	7.69	13.79	13.37	5.61	8.88	10.84
WORKED SLAB	CVOL	---	---	---	0	.18	.37
	QZT	---	---	---	0	.18	0
	CCS	---	---	---	0	0	0
	SED	---	---	---	.93	.12	.19
MANO/ GRINDING SLAB	CVOL	---	---	0	0	.18	0
	QZT	---	---	0	0	.06	.19
	CCS	---	---	0	0	0	0
	SED	---	---	1.07	1.87	1.01	1.50
MANO	CVOL	0	3.45	1.34	3.86	2.78	1.68
	QZT	3.85	6.04	1.07	.93	1.54	1.12
	CCS	0	0	.27	0	.59	.19
	SED	7.01	0	12.83	10.28	8.34	8.97
HAMMER STONE	CVOL	15.38	10.34	8.56	9.35	6.21	8.22
	QZT	0	3.45	.53	1.87	1.07	1.31
	CCS	0	---	2.94	1.87	1.36	0
	SED	0	---	.27	0	0	0
GROUND STONE INDETERM.	CVOL	15.38	6.90	8.29	21.50	12.37	10.47
	QZT	0	0	21.93	6.54	19.17	24.49
	CCS	0	3.45	.53	3.74	1.66	1.87
	SED	34.62	13.79	15.51	11.21	18.05	12.15
N=		26	29	374	107	1690	535
No. Clusters		9	20	134	34	1261	287

BLANK

PAGE

Table 6.56. FAR material types by temporal period.

Associations	Crystalline	Quartzite	Caliche/	Cryptocrystalline	Sandstone	N	
Ceramic							
Early Ceramic	.57	.57	89.71	0	9.14	175	20
Late Ceramic	2.90	.87	89.19	.28	6.28	2517	135
Unspecific Ceramic	2.68	1.41	92.52	.11	3.12	4397	287
Lithic							
Archaic	6.02	0	80.72	2.41	10.84	83	9
Formative Lithic	4.74	1.81	83.30	2.48	6.70	443	34
Unspecific Lithic	3.56	1.12	89.31	.41	5.49	10265	1261

proportion of Archaic and Early Ceramic assemblages as does sandstone FAR. The frequency of recycled groundstone in assemblages should be a good indicator of the intensity of the reuse of locations. Its presence in assemblages assigned to temporal categories and relationship to other lithic artifacts in assemblages is examined in Chapter 8.

Plate 6.1. a. Unit 28 Phase I, Folsom
b. 3SE-1742, Folsom
c. 110-185, Cody Complex
d. 21SE-1557, Cody Complex
e. 75-524, Jay
f. 110-120, Jay
g. 3SE-1972, Augustin
h. 3NE-19-3B, Augustin
i. 50-1774, Augustin
j. 21SW-11B, Datil

Plate 6.2. a. 25-2, San Jose
b. 75-400, Chiricahua (Small Variety)
c. 50-2117, San Pedro (Large Variety)
d. 45SW-126, San Pedro (Large Variety)
e. 21SE-789, San Pedro (Large Variety)
f. 75-3310, San Pedro (Small Variety)
g. 21NW-1444, San Pedro (Small Variety)
h. 3NW-969, En Medio-like
i. 110-1122, En Medio-like
j. 32-153, En Medio-like

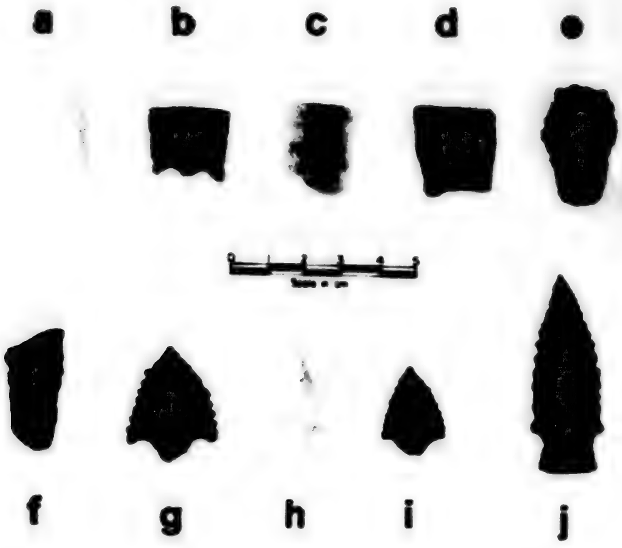


PLATE 6.1.

PALEOINDIAN AND ARCHAIC PROJECTILE POINTS.

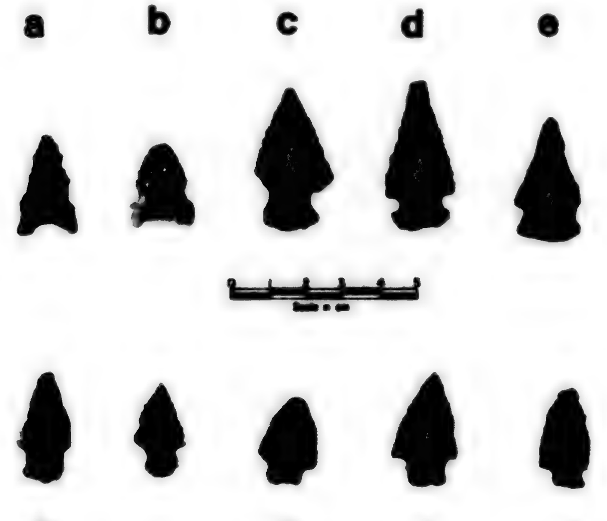


PLATE 6.2.

ARCHAIC AND EARLY FORMATIVE PROJECTILE POINTS.

Plate 6.3
a. 21SW-72, Unclassified
b. 45SE-2911, Unclassified
c. 21NW-585, Unclassified
d. 45NW-363, Figeroa-like
e. 1-525, Paisono-like
f. 32-605, Unclassified
g. 48NW-73, Unclassified
h. 110-231, Yarbrough-like
i. 2SE-554, Hayes-like
j. 3SE-29-7A, Unclassified
k. 32-382, Unclassified

Plate 6.4
a. 50-436, Scallorn
b. 3SE-8000, Bonham
c. 50-1784, Unclassified
d. 45SE-4013, Unclassified
e. 50-2150, Unclassified.

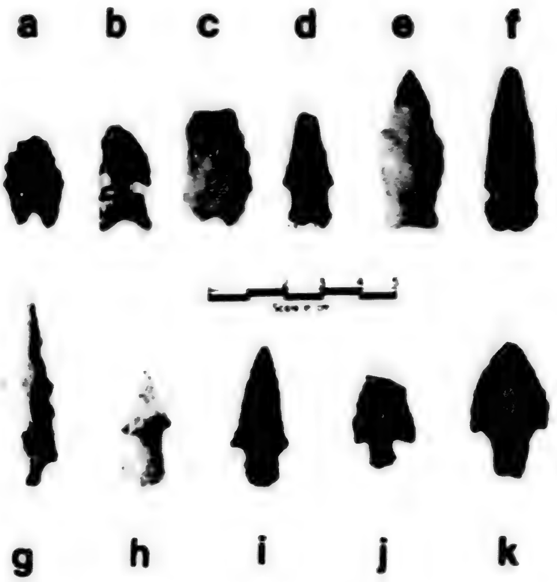


PLATE 6.3.

UNCLASSIFIED STEMMED AND OTHER PROJECTILE POINTS.

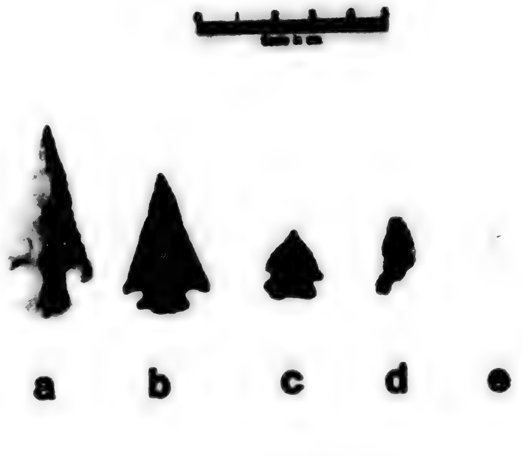


PLATE 6.4.

FORMATIVE PERIOD PROJECTILE POINTS.

CHAPTER 7

CERAMIC RECORDING PROCEDURES AND DESCRIPTIONS

In-field analysis of ceramics from intensively surveyed areas inventoried about 5,000 sherds. Subsequent to their analysis, all rim sherds and most decorated types were collected for further examination. In-field and laboratory coding procedures are described in the first portion of Chapter 7 and ceramic inventories are summarized in the following section.

CERAMIC RECORDING PROCEDURES

by Barbara J. Mills

This portion of Chapter 7 summarizes the recording procedures used during the analysis of 957 ceramic artifacts collected as part of the Bureau of Land Management's (BLM's) Hopi-Navajo Land Exchange Project (NHLEP), near El Paso, Texas. These artifacts were collected by BLM project personnel during the spring of 1985.

The ceramic sample analyzed consists of two major groups: (1) surface collections and (2) subsurface collections. The surface sample was collected primarily during the archaeological survey, although a small portion of the collection was made subsequent to the archaeological survey during the mapping stages of the survey. The surface sample was made according to two major criteria. First, all rim sherds, regardless of ceramic type, were collected. Second, all body sherds which were not identified as El Paso (plain) Brownware, Bichrome, or Polychrome by the survey crews were also collected. In contrast to the surface sample, the sherds analyzed from excavated proveniences includes all sherds, regardless of vessel portion represented or ceramic type. Thus, counts for the two samples are not completely comparable; there is an inherent bias toward higher counts of brownware body sherds in the subsurface samples.

The analysis included up to seven attributes for rim sherds, and up to four attributes for non-rim sherds. (Ceramic type, presence of a rim, vessel form and maximum sherd dimension were recorded in the field for all ceramics recording during survey. All other attributes were either coded or recoded subsequent to collection.) Each attribute is described below and the values for each attribute are listed in Table 7.1. All data from excavated collections were recorded during post-fieldwork analysis. Attributes were reviewed for collected ceramics which had been analyzed during survey and additional rim and vessel identifier attributes coded. At the completion of the attribute recording stage, the data were entered into a Wordstar microcomputer file and sent via modem to the University of New Mexico mainframe computer, where the BLM data files were maintained during report preparation.

Description of Ceramic Attributes Recorded

Ceramic Type (TP)

The ceramic types identified during the analysis and their frequencies within each of the two samples (surface and subsurface) are listed in Table 7.2. Assignment to a specific typological category was made according to the descriptions below. It should be noted that in those cases where several sherds of the same vessel were present, all sherds were assigned to the same type, regardless of whether each sherd had all attributes present for assignment to that type.

Most of the ceramics analyzed were plain brownwares. Two major separations of plain brownwares were made, those with the large-sized temper associated with El Paso Brownware and those with fine-grained temper (called "other brownware" here).

Within El Paso Brownware, six different categories were used to classify the sherds. The single most frequently used category was unspecific El Paso brownware. Following Anyon (1985), Hard (1983b), Whalen (1977, 1978, 1980), and others, this category was used for all El Paso brownware body sherds without any apparent evidence of paint. As these authors have pointed out, this category is necessary due to the difficulty in separating El Paso Brownware vessels from El Paso Bichrome and Polychrome vessels. Decoration on these latter two types is concentrated around the rim and necks of jars -- the predominant form of all El Paso Brownwares --

Table 7.1. Ceramic coding system for laboratory analysis.

---

1. TP (Ceramic Type)

1=Unspecific El Paso Brown /1/
2=El Paso Polychrome
3=El Paso Bichrome
4=Chupadero B/W
5=Unidentified Mimbres Whiteware
6=Smudged Indented Corrugated
7=Indented Corrugated Brownware
8=Unidentified red slipped ware
10=Fine-tempered polished brownware
19=Chihuahua Polychrome (undifferentiated)
24=Unidentified
25=Boldface B/W (Mimbres Style I)
27=Mimbres B/W (Mimbres Style III)
28=El Paso Brownware /2/
29=Clapboard Corrugated Brownware
30=Tooled Obliterated Corrugated Brownware
31=Smudged Plain Brownware
32=Obliterated Corrugated Brownware (EP paste)
33=Textured Brownware (fine temper)
34=Playas Red Textured
35=Obliterated Corrugated Brownware (fine temper)
36=Obliterated Corrugated Brownware, Smudged
37=Ramos Polychrome
38=Uniden. Glazed Mexican Polychrome
39=Textured Brownware (EP paste)

NOTES: /1/ Any brown body sherd with El Paso temper
/2/ Identified from rim sherds only

2. RIM
1=Rim Sherd

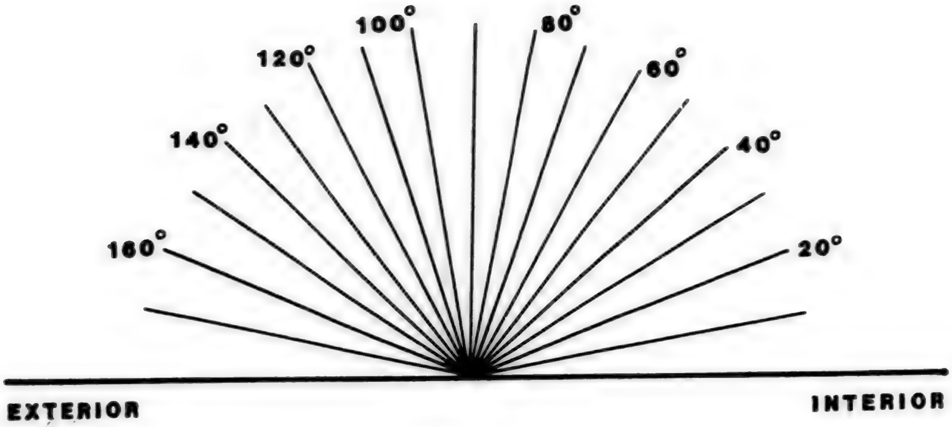
3. VF (Vessel Form)

1=Indeterminate
2=Jar
3=Bowl

4. RE (Rim Eversion)

Measured in 10 degree increments:

Table 7.1 (concluded).



EXTERIOR	INTERIOR
1=1 to 10 degrees 2=11 to 20 degrees etc...	99=Indeterminate

5. OD (RIM Diameter)

Measured in cm with spherometer
9999=Indeterminate

8888=OD calculation made on glued rimsherds, OD listed under other sherd

6. VID (Vessel Identifier #)

Unique number assigned to each unique vessel, based on two or more sherds of one vessel.

7. MOD (Modification)

1=Drilled
2=Edge Abrasion

8. RF (Rim Form)

1=Pinched
2=Rounded
9=Indeterminate

Table 7.2. Ceramic type frequencies for collected ceramics.

Ceramic Type	Surface Proveniences	Subsurface Proveniences	Total
El Paso Brownware			
Unspecific Brown	188	157	345
El Paso Brownware	89	3	92
El Paso Bichrome	144	8	152
El Paso Polychrome	20	2	22
Obliterated Corrugated Brown (EP)	20	0	20
Textured Brownware (EP)	47	0	47
Other Brownware			
Fine-tempered, Polished	32	12	44
Smudged Plain Brownware	9	0	9
Textured Brownware	3	0	3
Indented Corrugated	6	0	6
Smudged Indented Corrugated	2	0	2
Clapboard Corrugated	29	0	29
Obliterated Corrugated	9	2	11
Smudged Oblit. Corrugated	1	0	1
Tooled Oblit. Corrugated	20	0	20
Mimbres Whiteware			
Boldface Black-on-white	9	0	9
Mimbres Black-on-white	21	0	21
Uniden. Mimbres Whiteware	59	1	60
Other Whiteware			
Chupadero Black-on-white	15	0	15
Chihuahuan Wares			
Ramos Polychrome	10	0	10
Playas Red Textured	2	0	0
Undiff. Chihuahuan Poly	18	0	18
Other			
Uniden. Glazed Mexican Poly	5	0	5
Uniden. Red Slipped Ware	11	0	11
Uniden. Wares	9	1	10
TOTAL	771	186	957

and the vessel bodies are usually unpainted (Runyon and Hedrick 1973; Stallings 1931). Only rim and neck sherds may therefore be assigned with certainty to the category of El Paso Brownware. This problem is particularly acute with sherds from surface proveniences as the red paint used on El Paso Bichrome and Polychrome is often fugitive (Stallings 1931). Thus, counts of unspecific El Paso Brown comprise a category used to maintain the integrity of the other categories of El Paso Brownware, and potentially may include sherds from El Paso Brownware, Bichrome, and Polychrome vessels.

Sherds were placed in the category of El Paso Bichrome if either black or red paint, but not both, was present on a sherd. This category therefore includes both El Paso Red-on-brown and El Paso Black-on-brown (Runyon and Hedrick 1973). Although frequencies by paint color were not tabulated separately, black paint occurred more commonly than red paint.

Many sherds placed within the category of El Paso Bichrome may represent portions of El Paso Polychrome vessels. Only sherds with both black and red paint were classified as El Paso Polychrome. Thus, while the category of El Paso Bichrome may contain sherds from polychrome vessels, the converse of this is not true -- no El Paso Bichrome vessels may be misclassified as El Paso Polychrome.

Two other brownware types were identified with El Paso pastes. This included sherds of at least two obliterated corrugated vessels. One of these vessels was polished over the obliterated, but still visible coils. Another unusual brownware type with typical El Paso paste was represented by 47 sherds of a single textured jar. The neck of the jar was parallel incised while the body had been punched with a wedge-shaped tool.

As noted above, non-El Paso or "other" Brownwares were separated from El Paso brownwares on the basis of the presence of more fine-grained temper. This includes both plain and various corrugated types. Some of the sherds in the category of fine-tempered polished brownware fit existing descriptions of Jornada Brown (e.g. Human Systems Research 1973; Runyon and Hedrick 1973). However, due to the potential for confusion with other brownwares, it has been classified here as "fine-tempered polished brownware." Anyon (1985) has advocated including sherds of this description in the unspecific El Paso Brownware category based on the overlapping ranges of temper size in the existing descriptions of Jornada and El Paso Brownwares. But, because of the distinctive co-occurrence of temper size and polish this category was maintained separately during the present analysis. Some of the fine-tempered brownware sherds contain relatively abundant amounts of mica.

One large rim sherd from a surface context (E#462) was noticeably different from the other sherds placed in the fine-tempered plain brown category. Its paste was a darker brown to black and the surface less well-polished. The form of this jar suggests it may be an Apachean vessel.

Corrugated brownwares of various types are also present in the collections. None of these have the typical large-sized El Paso Brownware temper, and probably represent sherds of both the Alma and Jornada Brownwares. Different treatments of corrugations were tabulated separately, as was the presence of smudged interior surfaces. The types tabulated separately include: Smudged Indented Corrugated, Indented Corrugated Brownware, Clapboard Corrugated Brownware, Tooled Obliterated Corrugated Brownware, Smudged Plain Brownware, Textured Brownware, Obliterated Corrugated Brownware, and Smudged Obliterated Corrugated Brownware. These separations were made because the different treatments of corrugations have been shown to have chronological significance throughout the Southwest, and because the presence of smudged surfaces may represent an attribute of potential functional significance.

Most of the white slipped wares present within the collections are Mimbres Whiteware. The two Mimbres whiteware types of Boldface Black-on-white (Mimbres Style I) and Mimbres Black-on-white (Mimbres Style III) were differentiated on the basis of stylistic criteria, as discussed by Anyon and LeBlanc (1984) and Scott (1983). A third type or style transitional between Boldface and Mimbres Black-on-whites (Style II) has also been described by these authors, but was not present within the present project's collections. If whiteware sherds could not be definitively placed within either of the two identified Mimbres

Whiteware types, they were placed in the category of unidentified Mimbres Whiteware.

Chupadero Black-on-white is the only other white slipped type within the collections. This type was differentiated from Mimbres Whiteware on the basis of its uniform gray paste and black volcanic temper. Although scoring of non-painted surfaces is a frequent diagnostic of Chupadero Black-on-white (Mera 1931), as Runyon and Hedrick (1973) point out, this scoring does not have to be present to assign a sherd to this type.

Chihuahuan wares present within the collections include both polychrome and textured types. One vessel of Ramos Polychrome was positively identified, based on a comparison of 10 sherds of this vessel with the Casas Grandes type collection at the Laboratory of Anthropology, Museum of New Mexico. Other Chihuahuan Polychromes were not positively identified, but were tabulated together as undifferentiated Chihuahuan Polychrome. All of these are vessels with well-polished buff surfaces and matte red and black paints. These are probably portions of Ramos Polychrome vessels. Another Chihuahuan type identified was Playas Textured, generally fitting previously published descriptions of Playas Red and its variants by Rinaldo (1974).

A few sherds of an unidentified redware are also present in the collection and were tabulated separately as an unidentified red slipped ware. These undecorated sherds are probably San Francisco Red, but their eroded surfaces precluded positive identifications.

Finally, five sherds of a recent historic or modern glazed Mexican Polychrome jar were tabulated. This vessel has a fine terracotta paste, red-orange glazed surface, and black and white painted decoration.

Presence of Rim (RIM)

In order to provide a convenient way to sort rim sherds, all sherds with any portion of the rim evident were given a separate value under this attribute. Usually, the presence of the lip itself was used to differentiate rim sherds, but in a few cases, the lip was eroded off. Missing values denote non-rim sherds.

Vessel Form (VF)

Vessel form was recorded as one of three values: indeterminate, jars, and bowls. Most non-rim sherds are indeterminate as to form because of the lack of clear differences between interior and exterior surfaces. In the case of painted sherds, non-rim or body sherds may be fairly reliably identified as bowls or jars. Only those unpainted body sherds with enough of the form represented were identified as to one of these two forms. In general, however, most of the types present in the collection are biased toward only one form. This may be inferred from the relative frequencies of bowls versus jars among the assemblage of rim sherds (Table 7.3).

Rim Eversion (RE)

For rim sherds only, rim eversion was measured in 10 degree increments, with the inside surface facing zero degrees. Rim sherds were oriented as they would have been on the whole vessel and the angle most closely following the angle along the interior surface of the rim was recorded. If this orientation could not be ascertained, a "99" was entered. Missing values denote non-rim sherds.

Rim eversion was chosen for recording in order to provide an interval scale for assessing the presence of different rim forms among El Paso area jars. Different jar forms are probably indicative of differences in vessel function.
For the El Paso Brownwares, Whalen (1978, 1980) has suggested that jar forms -- as monitored in part by rim form -- changed through time and may therefore be used as chronological indicators.

Most of the jar rims are El Paso Brownware, Bichrome, or Polychrome. Two modes of rim eversion, highly inverted or everted, are present among the jars, while the bowls show a perfect unimodal distribution around straight rims. Highly inverted rims indicate the vessel was probably a neckless form, while those with everted rims are necked forms.

Rim Diameter (OD)

RIM diameter was calculated using those rim sherds of at least 20 millimeters in length. If

Table 7.3. Frequencies of vessel form by ceramic type for rim sherds.

Ceramic Type	Vessel Form		
	Bowl	Jar	Indeterminate
El Paso Brownware			
El Paso Brownware	5	69	9
El Paso Bichrome	11	49	7
El Paso Polychrome	3	14	0
Textured Brown (EP)	0	1	0
Other Brownware			
Fine-tempered, Polished	2	1	0
Indented Corrugated	0	1	0
Clapboard Corrugated	1	1	0
Tooled Oblit. Corrugated	0	1	0
Mimbres Whiteware			
Boldface Black-on-white	3	0	0
Mimbres Black-on-white	8	0	0
Uniden. Mimbres Whiteware	4	0	0
Other Whiteware			
Chupadero Black-on-white	1	1	0
Chihuahuan Wares			
Ramos Polychrome	0	1	0
Undiff. Chihuahuan Poly	0	1	0
Other			
Uniden. Glazed Mexican Poly	0	1	0
TOTAL	38	141	16

Table 7.4. Rim eversion by vessel form.

```
RIM EVERSION    VESSEL FORM

 FREQUENCY
  PERCENT ! JARS    ! BOWLS  !  TOTAL
 ---------+--------+--------+
 6        !      3 !      0 !      3
          !   2.10 !   0.00 !   2.10
 ---------+--------+--------+
 7        !     10 !      0 !     10
          !   6.99 !   0.00 !   6.99
 ---------+--------+--------+
 8        !     15 !      1 !     16
          !  10.49 !   0.70 !  11.19
 ---------+--------+--------+
 9        !      9 !      7 !     16
          !   6.29 !   4.90 !  11.19
 ---------+--------+--------+
 10       !     16 !     19 !     35
          !  11.19 !  13.29 !  24.48
 ---------+--------+--------+
 11       !     28 !      7 !     35
          !  19.58 !   4.90 !  24.48
 ---------+--------+--------+
 12       !     21 !      1 !     22
          !  14.69 !   0.70 !  15.38
 ---------+--------+--------+
 13       !      5 !      0 !      5
          !   3.50 !   0.00 !   3.50
 ---------+--------+--------+
 14       !      1 !      0 !      1
          !   0.70 !   0.00 !   0.70
 ---------+--------+--------+
   TOTAL         108       35      143
               75.52    24.48   100.00
```

a rim sherd was less than this in length, "9999" was entered into the file. If two rim sherds were able to be fit together, they were glued and only one OD estimate was entered. An "8888" was entered next to the second sherd contributing to the estimate.

Rim diameter as used here refers to the diameter of the vessel ca. 3 millimeters below the interior of the lip. This attribute was measured with a spherometer consisting of a Starret dial indicator and removable brass appendages of varying lengths, according to a method discussed in greater detail by Plog (1985). Rim diameter measurements were calculated in MBASIC using the following formula:

$$OD\ (mm) = (((X/2)\quad 2)+((Y-Z)\quad 2))/(Y-Z)$$

The resulting values were converted to centimeters and rounded to the nearest one-tenth centimeter. Figure 7.1 is a histogram of rim diameters. A total of 69 sherds were able to be measured for this attribute.

Vessel Identifier # (VID)

Sherds representing portions of the same vessels were identified and each vessel was given a unique identifying number. A total of 176 (1-176) vessel numbers were assigned. Sherds from the same unit were analyzed and sorted at the same time and any possible matches were identified. In many cases, sherds were found which fit together. Once possible matches had been identified on the basis of surface treatment, fresh breaks exposing the paste were made and the sherds were compared. Rim sherds were considered more reliable for matching purposes. A missing value for this attribute indicates that no matches were identified, that is, there is only one sherd per vessel in the collections.

Modification (MOD)

Any sherds which showed evidence of intentional modification were so noted. Two different forms of modification were present within the collections: drill holes and edge abrasion or grinding. In contrast to some collections from the El Paso area (e.g. Hard 1973), modifications of either kind were rarely encountered.

Rim Form (RF)

Rim form was recorded for all rim sherds. In the few cases where rims were heavily eroded, a "9" was recorded to indicate that the value is indeterminate. Otherwise, either pinched or rounded rim forms were identified. Whalen (1980) has suggested that El Paso Brownware pinched rims chronologically precede rims which are rounded. While this suggestion has not been definitively tested, the attribute of rim form was coded in order to provide the potential to chronologically separate ceramics within the collection. This attribute should be used in conjunction with the attribute of rim eversion. Everted rims are apparently later in the tentative chronological sequence (Whalen 1978:Figure 69) and any values of pinched rim form associated with everted rims should not be considered to be as early as pinched, inverted rims.

CERAMICS IN PHASE II SURVEY UNITS

This section of Chapter 7 describes the ceramics recorded during the Phase II intensive survey. A portion of the ceramic population recorded during the intensive survey which includes all rim sherds regardless of type and all body sherds which were not El Paso (plain) Brownware or El Paso Bichrome or Polychrome has been described in the previous section. All sherds inventoried during the intensive survey including the above mentioned group are discussed in the following description of ceramic types and type attributes.

Table 7.5 lists ceramic types inventoried during the intensive survey. Highest frequencies of sherds are Unspecific (plain) El Paso Brownware. El Paso Bichrome and El Paso Polychrome are also moderately abundant. Ceramic types are broken down by survey unit in Table 7.6. The larger 800 x 800 meter survey units occur on the interior mesa top in Survey Area III and the smaller 400 x 400 meter units in Survey Areas I and II situated along the West Mesa scarp. Comparing ceramic frequencies in survey units along the mesa scarp with those in interior mesa top units which have been divided into quadrants, ceramic counts average 236.62 in mesa scarp units and are slightly lower, an average of 166.05 sherds per unit, in interior mesa top units. This comparison is a biased one in that areas of highest ceramic density lying near the mesa scarp

Figure 7.1. Histogram of Rim Diameters.

```
MIDPOINT
OD                                                                                        FREQ  CUM.  PERCENT      CUM.
                                                                                                FREQ            PERCENT
     |
12   |************************************************************************************  21    21    30.43     30.43
     |
18   |************************************************************************              18    39    26.09     56.52
     |
24   |********************************************************************                  17    56    24.64     81.16
     |
30   |****************************                                                           7    63    10.14     91.30
     |
36   |********                                                                               2    65     2.90     94.20
     |
42   |************                                                                           3    68     4.35     98.55
     |
48   |****                                                                                   1    69     1.45    100.00
     |
     ----+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
         1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21

                                        FREQUENCY
```

Table 7.5 Ceramic types in Phase II survey units.

El Paso Brownware		
Unspec ElPasoBrn	4,004	76.8
El Paso Brownwre	92	1.8
El Paso Bichrome	387	7.4
El Paso Polychme	292	5.6
Obiltr Corr Brn	20	0.4
TexturedBrnwreEP	46	0.9
FT PolshBrownwre	58	1.1
Smudged PlainBrn	13	0.2
TexturedBrownwre	15	0.3
Other Brownware		
IndentedCorrugtd	9	0.2
Smudged Ind Corr	3	0.1
Clapbrd Corrugtd	28	0.5
Oblitr Corrugtd	9	0.2
Smudged ObltCorr	1	0.0
Tooled ObltCorr	19	0.4
Mimbres Whiteware		
Boldfce B/W	10	0.2
Mimbres B/W	21	0.4
Unident MimbrsWW	65	1.2
Other Whiteware		
Chupadero B/W	41	0.8
Chihuahuan Wares		
Ramos Polycrme	10	0.2
Playas RedTexrd	2	0.0
Undiff ChihPoly	12	0.2
Other Wares		
Unident GlMexPly	5	0.1
Unident RdSlipWr	12	0.2
Unident Wares	40	0.8
TOTALS	5,214	

were systematically excluded from the intensive survey. It does show, however, that interior mesa top surfaces are generally comparable to low density surfaces along the mesa scarp in terms of ceramic abundance.

Vessel form was coded during in-field analysis for all body sherds and in the laboratory for all collected rim and body sherds (see previous section). In-field analysis of vessel form attribute was conservative in that this attribute was coded as indeterminate for most sherds, 52.6 percent. Jar sherds make up 37.1 percent and bowl sherds 10.2 percent of the recorded ceramics. Two ladle fragments were also recorded. Vessel form and type frequencies are listed separately for rim and body sherds in Table 7.7.

It is important to assess the differences in vessel form proportions as represented in body and rim sherd assemblages. This can be only be satisfactorily accomplished for El Paso Brownware rims and plain body sherds and for El Paso Bichrome and Polychrome, since it is these types which include minimum frequencies of rim sherds necessary for comparison. Comparing all sherds with only rim sherds, no differences in bowl and jar frequencies exist for El Paso Bichrome or El Paso Polychrome (Chi-square, probability level = 0.05).

Since extremely few El Paso Brownware bowl rims were recorded, differences in bowl and jar proportions are greater, but still not significant at the 0.001 probability level, between Unspecific El Paso (plain) Brownware and El Paso Brownware (rims) (Chi-square=8.90, $\underline{p}$=0.002,df=1). This greater difference is probably due in part to the fact that Unspecific Brownware body sherds may belong to any of the other three types considered here. Using all four types (Unspecific El Paso [plain] Brownware, El Paso Brownware rims, El Paso Bichrome, and Polychrome) no strong differences in jar and bowl proportions exist between samples of all sherds and samples of only rim sherds (Chi-square=4.33, $\underline{p}$=0.037, df=1), nor does any difference in vessel form exist when rim and body sherds of all types are compared together with only rim sherds of all types.

While the above comparisons are not conclusive evidence that the ceramic inventory of both body

Table 7.6. Ceramic type frequencies by survey unit.

a. 800 x 800 meter survey units.

Frequency Row Pct	Unspec El Paso	El Paso Brownwre	El Paso Bichrome	El Paso Polychme	Obiltr Corr Brn	Textured BrnwreEP	FT Polsh Brownwre	Smudged PlainBrn	Textured Brownwre	Indented Corrugtd	Smudged Ind Corr	Clapbrd Corrugtd	Oblitr Corrugtd	Smudged ObltCorr	Tooled ObltCorr	Boldface B/W	Mimbres B/W	Unident MimbrsWW	Chupader B/W	Ramos Polycrme	Playas RedTexrd	Undiff ChihPoly	Unident GlMexPly	Unident RdSlipWr	Unident Wares	Total
2	157 90.75	4 2.31	2 1.16	3 1.73	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	7 4.05	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	173
3	930 83.18	25 2.24	60 5.37	41 3.67	10 0.89	0 0.00	8 0.72	3 0.27	0 0.00	3 0.27	1 0.09	2 0.18	0 0.00	0 0.00	13 1.16	0 0.00	2 0.18	7 0.63	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	11 0.98	2 0.18	1118
21	705 76.55	11 1.19	41 4.45	58 6.30	10 1.09	0 0.00	16 1.74	6 0.65	0 0.00	1 0.11	0 0.00	13 1.41	4 0.43	1 0.11	0 0.00	0 0.00	4 0.43	38 4.13	9 0.98	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	4 0.43	921
45	101 90.18	2 1.79	7 6.25	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.89	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.89	112
48	840 84.25	34 3.41	23 2.31	16 1.60	0 0.00	0 0.00	20 2.01	0 0.00	3 0.30	2 0.20	0 0.00	4 0.40	5 0.50	0 0.00	6 0.60	10 1.00	7 0.70	5 0.50	2 0.20	0 0.00	0 0.00	0 0.00	0 0.00	1 0.10	19 1.91	997

Table 7.6. (concluded)

b. 400 x 400 meter survey units.

Frequency Row Pct	Unspec El Paso	El Paso Brownwre	El Paso Bichrome	El Paso Polychme	Obiltr Corr Brn	Textured BrnwreEP	FT Polsh Brownwre	Smudged PlainBrn	Textured Brownwre	Indented Corrugtd	Smudged Ind Corr	Clapbrd Corrugtd
1	11 45.83	0 0.00	0 0.00	10 41.67	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	3 12.50	0 0.00	0 0.00
3	7 58.33	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
16	2 50.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
25	259 63.17	2 0.49	52 12.68	75 18.29	0 0.00	0 0.00	1 0.24	4 0.98	0 0.00	0 0.00	0 0.00	4 0.98
32	29 55.77	0 0.00	7 13.46	6 11.54	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
50	847 69.31	14 1.15	168 13.75	71 5.81	0 0.00	46 3.76	11 0.90	0 0.00	12 0.98	0 0.00	2 0.16	0 0.00
75	77 60.16	0 0.00	27 21.09	12 9.38	0 0.00	0 0.00	1 0.78	0 0.00	0 0.00	0 0.00	0 0.00	4 3.13
110	39 95.12	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 2.44	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
Total	4004	92	387	292	20	46	58	13	15	9	3	28

Oblitr Corrugtd	Smudged ObltCorr	Tooled ObltCorr	Boldface B/W	Mimbres B/W	Unident MimbrsWW	Chupader B/W	Ramos Polycrme	Playas RedTexrd	Undiff ChihPoly	Unident GlMexPly	Unident RdSlipWr	Unident Wares	Total
0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	24
0 0.00	0 0.00	0 0.00	0 0.00	5 41.67	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	12
0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 50.00	0 0.00	0 0.00	0 0.00	0 0.00	4
0 0.00	0 0.00	0 0.00	0 0.00	1 0.24	2 0.49	0 0.00	0 0.00	0 0.00	10 2.44	0 0.00	0 0.00	0 0.00	410
0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	9 17.31	0 0.00	0 0.00	1 1.92	0 0.00	0 0.00	0 0.00	52
0 0.00	0 0.00	0 0.00	0 0.00	1 0.08	5 0.41	21 1.72	10 0.82	0 0.00	0 0.00	0 0.00	0 0.00	14 1.15	1222
0 0.00	0 0.00	0 0.00	0 0.00	1 0.78	1 0.78	0 0.00	0 0.00	0 0.00	0 0.00	5 3.91	0 0.00	0 0.00	128
0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 2.44	0 0.00	0 0.00	0 0.00	41
9	1	19	10	21	65	41	10	2	12	5	12	40	5214

Table 7.7a. Vessel form and type frequencies of body sherds.

Frequency Col Pct	Unspec El Paso	El Paso Bichrome	El Paso Polychme	Obiltr Corr Brn	Textured BrnwreEP	EP Polsh Brownwre	Smudged PlainBrn	Textured Brownwre	Indented Corrugtd	Smudged Ind Corr	Clapbrd Corrugtd	Oblitr Corrugtd	Smudged Ind Corr	Tooled ObltCorr	Boldface B/W	Mimbres B/W	Unident MimbrsWW	Chupader B/W	Ramos Polycrme	Playas RedTexrd	Undiff ChihPoly	Unident GlMexPly	Unident RdSlipWr	Unident Wares	Total
indeterm	2384 59.79	144 45.00	67 24.63	20 100.00	0 0.00	24 44.44	8 66.67	3 20.00	3 37.50	2 66.67	16 61.54	9 100.00	1 100.00	1 5.56	0 0.00	1 7.69	4 6.67	1 2.56	3 33.33	0 0.00	0 0.00	0 0.00	1 8.33	19 48.72	2711
jar	1267 31.78	164 51.25	170 62.50	0 0.00	45 100.00	5 9.26	0 0.00	12 80.00	5 62.50	0 0.00	7 26.92	0 0.00	0 0.00	17 94.44	0 0.00	0 0.00	3 5.00	34 87.18	6 66.67	2 100.00	11 100.00	4 100.00	11 91.67	18 46.15	1781
bowl	333 8.35	12 3.75	35 12.87	0 0.00	0 0.00	25 46.30	4 33.33	0 0.00	0 0.00	1 33.33	3 11.54	0 0.00	0 0.00	0 0.00	7 100.00	12 92.31	53 88.33	4 10.26	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 5.13	491
ladle	2 0.05	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2
other	1 0.03	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1
Total	3987	320	272	20	45	54	12	15	8	3	26	9	1	18	7	13	60	39	9	2	11	4	12	39	4986

Frequency Missing : 22

Table 7.7b. Vessel form and type frequencies of rim sherds.

Frequency Col Pct	El Paso Brownwre	El Paso Bichrome	El Paso Polychme	Textured BrnwreEP	FT Polsh Brownwre	Smudged PlainBrn	Indented Corrugtd	Clapbrd Corrugtd	Tooled ObltCorr	Boldface B/W	Mimbres B/W	Unident MimbrsWW	Chupader B/W	Ramos Polycrme	Undiff ChihPoly	Unident GlMexPly	Unident Wares	Total
indeterm	10 10.87	8 11.94	1 6.67	0 0.00	1 25.00	1 100.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 100.00	22
jar	77 83.70	48 71.64	12 80.00	1 100.00	1 25.00	0 0.00	1 100.00	1 50.00	1 100.00	0 0.00	0 0.00	0 0.00	1 50.00	1 100.00	1 100.00	1 100.00	0 0.00	146
bowl	5 5.43	11 16.42	2 13.33	0 0.00	2 50.00	0 0.00	0 0.00	1 50.00	0 0.00	3 100.00	8 100.00	5 100.00	1 50.00	0 0.00	0 0.00	0 0.00	0 0.00	38
Total	92	67	15	1	4	1	1	2	1	3	8	5	2	1	1	1	1	206

and rims sherds can be used with complete assurance to estimate vessel form frequencies, they do indicate that using the West Mesa ceramic data vessel form frequencies as interpreted from a sample all sherds will probably not differ radically from those based only on a sample of rim sherds. Analysis of body and rim sherds together for the purpose of determining vessel form widens the scope of comparisons possible with the West Mesa ceramic data, since extremely few rim sherds are available for analysis. Comparison of vessel form among spatial associations of artifacts which are similar in lithic content is taken up in Chapter 8.

Trends in rim morphology noted by Whalen (1980) and subsequently investigated by Carmichael (1983:76-78) and Seaman and Mills (1986) include tapered rims on Mesilla Phase vessels, direct flattened rims in the Dona Ana Phase, and rounded thickened rims in the El Paso Phase, although overlap in rim morphology between phases has been noted (Carmichael 1983:78; Seaman and Mills 1986). Rim eversion and rim form attributes of El Paso Brownwares can be reviewed here but with very low sherd frequencies in most classes (Table 7.8). El Paso Brown jars are evenly divided between neckless and necked forms. Rim attributes of most El Paso Bichrome and Polychrome jar sherds indicate necked forms with rounded rims predominating. Of the five El Paso Brown bowl rims recorded, most are rounded while most Bichrome bowl rims are pinched.

Given the extremely low frequencies of rims, the ceramic chronology proposed by Whalen (1980) that relies on variation in form and eversion will not be pursued here. Ceramic types have been used, however, to group spatial associations of artifacts into temporal categories (see Chapter 6). The presence of Mimbres Style I Whiteware, the only early decorated type that occurs in the documented West Mesa ceramic assemblage, Textured Brownware, and Clapboard Corrugated Brownware (Anyon and LeBlanc 1984; Scott 1983) were used to identify Early Ceramic associations. Late Ceramic associations were identified based on the presence of El Paso Bichrome, El Paso Polychrome, Chupadero Black-on-white, Ramos and other undifferentiated Chihuahuan Polychromes, and Mimbres Style III Whiteware (Anyon and LeBlanc 1984). Late Ceramic utility wares include Indented, Obliterated, and Tooled Obliterated Corrugated types, and Playas Red Textured (Rinaldo 1974).

Undecorated El Paso Brownware sherds not exhibiting a rim remnant, were classed as Unspecific El Paso Brown (Hard 1983b; Whalen 1980), a type used along with unidentified types to distinguish the Unspecific Ceramic category. Unspecific El Paso Brown serves as a residual type used to avoid misclassification of sherds from undecorated bodies of bichrome and polychrome vessels (decoration is only applied to the rims and upper portions of these vessels) as El Paso Brown and, thus, includes sherds from undecorated and decorated types.

While spatial associations in each temporal group may not exclusively represent occupations during a particular period or phase, assignment of artifact clusters to such groupings allows examination of conventional units of observation, in the form of spatial aggregates assigned to different time periods, for variation in spatial sturcture and assemblage contents. Temporal groupings are referenced in the following analyses of spatial association content in Chapter 8 and feature assemblages in Chapter 9.

Table 7.8. Rim eversion and rim form for El Paso Brownware type.

a. El Paso Brown

	JARS			BOWLS
	Inverted Rims	Everted Rims	Totals	Everted Rims
Pinched	14	5	19	1
Rounded	8	18	26	4
Totals	22	23		5

b. El Paso Bichrome

	JARS			BOWLS
	Inverted Rims	Everted Rims	Totals	Everted Rims
Pinched	1	0	1	8
Rounded	2	39	41	3
Totals	3	39		11

c. El Paso Polychrome

	JARS			BOWLS
	Inverted Rims	Everted Rims	Totals	Everted Rims
Pinched	2	1	3	0
Rounded	0	6	6	3
Totals	2	7		3

CHAPTER 8

SPATIAL ANALYSIS OF THE DISTRIBUTIONAL DATA BASE

This chapter examines past land use in the Mesilla Bolson with a distributional data base. The first section of Chapter 8 compares the content of low density artifact distributions in areas bordering the West Mesa scarp in order to discern whether the structure of artifact and feature distributions in all survey units there results from the same type of occupational history. Spatial associations of artifacts and features in Survey Areas 1, 2, and 3 are then analyzed for differences in their histories of use, a comparison that points to the differential exposure and visibility of archaeological surface materials. This differential exposure, visibility and, thus, discoverability of the surficial archaeological record is addressed in the final section of Chapter 8.

Site surveys of large tracts of land in the Mesilla Bolson are comparatively few consisting for the most part of seismic clearance surveys (Hilley 1982; Leftwich and Proper 1983a, 1983b, 1984; Heinsch 1980; Hilley 1981; Laumbach 1982). Recent surveys of the Dona Ana County Airport (Moore and Bailey 1980), the proposed Anapra off-road vehicle (ORV) area (Taylor 1981) and the Santa Teresa Exchange Area (Ravesloot and others 1986) have recorded larger areas extending from the western edge of the Rio Grande floodplain to about 4 miles west of the West Mesa scarp.

Two main characteristics of site distributions have been noted with these project data: (1) sites become smaller with increasing distance (to the west) from the West Mesa scarp, and (2) interior basin sites lack high artifact densities and architectural remains, the definitional criteria of habitations, and are therefore attributed to seasonal hunting and gathering activities. Other conclusions reached include use of the mesa, especially in the vicinity of playas, for hunting and gathering and intensive plant food processing which is inferred from high frequencies of groundstone (Taylor 1981; Hilley 1981). Conclusions drawn from the analyses presented here call into question reconstructions of site function which equate archaeological material directly with past events or activities. Instead, analyses focus on histories of land use and possible interactions between behavioral and natural post-depositional processes. First, possible behavioral strategies are investigated with analyses of survey unit content. Then the interplay of past behavioral processes and natural post-depositional processes is considered through an examination of the differential visibility of archaeological surface materials.

OCCUPATIONAL HISTORIES OF LOW DENSITY DISTRIBUTIONS ON THE WEST MESA SCARP

The West Mesa scarp is peripheral to the Rio Grande floodplain and the permanent and seasonal residential bases located there (cf. O'Laughlin 1980:Figure 6). Within survey Areas 1 and 2, low surface artifact densities along the scarp are interspersed with and border high density concentrations of ceramics, groundstone, and lithics. On the basis of their associated features, adobe walled structures, and surficial ash staining probably indicative of midden or trash deposits, some high density distributions could be inferred to represent residences utilized on at least a semi-permanent basis.

Six 400 x 400 meter quadrats--survey Units 1, 25, 32, 50, 75 and 110--found to contain relatively low density distributions of artifacts and features on a portion of the mesa top near the West Mesa scarp were intensively surveyed. Surficial artifact distributions in these mesa top survey units may represent the accumulated debris from the systematic use and reuse of areas peripheral to more intensively used residential bases on the floodplain and mesa top. Reuse of places on the mesa top may have focused on abandoned residences which served as points of reference on the West Mesa landscape. These "known" locations of abandoned or discarded implements and debris were available for scavenging to meet unanticipated tool requirements. Some could also have served as caching locations for hunting and gathering gear, agricultural implements, or other containers and tools which were seasonally reused at field locations away from a main residence. Over a long time span, many places may have functioned in several of these capacities.

If portions of the mesa top were used periodically in a systematic and redundant fashion for one purpose, while other areas were used for a different function, this should be discernible from examination of the content of distributions. The result should be identification of locations or places which served as the sites of functionally distinct occupations. Since mesa top distributions lie on deflated interdunal surfaces, however, they almost certainly represent debris accumulated in the course of multiple events, the sum of a series of "random" superimpositions of events resulting in an archaeological record which appears generally constant and continuous in terms of its composition of tools, containers, and imported raw materials.

Given this latter model of the history of the use of the West Mesa surface, identification of specific activity areas or particular sites of occupations may not be a realistic analytical goal, or even an attainable one. Systematic reuse of areas with similar strategies of tool and container use should, however, be indicated by distributions with comparable structure; that is, distributions in which the associations of items and the proportional relationships between items within associations are similar. Spatial associations of artifacts and features in survey Areas 1 and 2 are examined for similarities in assemblage structure by comparing surveyed mesa top artifact distributions.

Lithic Artifact Taxonomy

In order to compare spatial associations of cultural material for evidence of different histories of accumulation, a set of 14 lithic categories was derived which would allow interpretations of strategies of tool manufacture and use. This lithic artifact taxonomy was chosen for its ability to inform on production technique, degree of core reduction, tool use, possible tool caching, and groundstone recycling. These categories are:

1. Unutilized Chipped Stone Debris -- All unutilized angular debris and chunks which are not sandstone or quartzitic sandstone (since these latter items are most likely to be groundstone fragments, they are not included in this variable).

2. Biface Thinning Flakes -- Biface thinning flakes and distal thinning flake fragments.

3. Bipolar Flakes -- All bipolar flakes and obsidian flakes.

4. Undifferentiated Flake Debris -- Unutilized undifferentiated flakes which are not sandstone or quartzitic sandstone.

5. Late Stage Flakes -- Complete platform-bearing flakes which are not sandstone or quartzitic sandstone with a stage measure of greater than 5.

6. Small Cores -- All core types smaller than 6 centimeters in maximum dimension.

7. Large Cores -- All core types with a maximum dimension of 6 centimeters or greater.

8. Formal Tools -- Uniface and Biface 3 tool classes and projectile points.

9. Utilized Flakes and Angular Debris -- Items classed and flakes and angular debris which exhibit edge modification in the form of utilization or edge retouch.

10. Incomplete Groundstone -- Indeterminate groundstone fragments and other groundstone types coded as incomplete.

11. Complete Mano -- Any mano type coded as complete.

12. Complete Hammerstone -- Any hammerstone type coded as complete.

13. Fire-altered Groundstone -- Any groundstone item exhibiting fire-altered attributes of discoloration and angular fracture.

14. Non-carbonate Fire-altered Rock -- Fire-altered rock without artifactual attributes which is not limestone or caliche.

Bifacial core reduction and bipolar anvil-held core reduction are evidenced by biface reduction and bipolar flakes, while most undifferentiated flakes are produced through direct percussion of hand-held cores. Flakes measured for a stage variable monitor the degree of core reduction in assemblages. A majority of the groundstone in distributions is highly fragmented in addition to having been subject to heat alteration. Fire-altered groundstone and non-carbonate fire-altered rock categories, presumably recycled groundstone as well, gauge degree of groundstone recycling.

Methods

Spatial associations of artifacts and features lying on the interdunal surface of the West Mesa form the units of analysis in this comparison of survey unit content. These arbitrary associations are devised by clustering the x and y locational coordinates of artifacts and features and represent, simply, clusters of spatially associated material. Spatial associations can be thought of as portions of interdunal surfaces broken up into relatively compact distributions, the center points of which are located no more than 20 meters from one another. The modal size of associations is about 50 square meters. These associations cannot be assumed to represent temporally associated materials in any way; they are, rather, sets which have resulted from the reuse of places over long time periods, visible to the archaeologist as a result of the operation of general as well as local natural surface processes.

The size, density, and general content of spatial associations or clusters in Area 1 and 2 survey units are listed in Table 8.1. It is apparent from inspection of this table that Unit 1 differs from the others in that proportions of FAR in its component spatial clusters is extremely high. Unit 1 contains 15 features, 14 of which consist of mounded accumulations of FAR. As described in Chapter 4, Archaeological Reconnaissance and Distributional Survey for the NHLEP, high densities of FAR characterize Survey Area 1 straddling the West Mesa scarp and badlands topography on the western edge of the Rio Grande Valley. Unit 50 differs from the other Area 2 survey units in that relatively high proportions of ceramics prevail with fewer items of chipped stone present in the spatial clusters within this unit.

The 14 lithic classes listed above were calculated for each of the spatial associations in each survey unit (Table 8.2) and a singular value decomposition (SVD) was performed using the multivariate analysis program ANTANA (Harpending and Rogers 1984). This routine examines the principal components or principal coordinates of a matrix of normalized data. Analysis focuses on lithic classes and underlying factors which may be responsible for the relationships between these classes in spatial clusters within each of the survey units. For example, the spatial clusters in a survey unit may "rank" high with respect to incomplete and fire-altered groundstone and low on flake and angular debris. The factor responsible for this may be differential clusteredness--spatial associations within the unit may contain clustered discarded and recycled groundstone versus relatively dispersed chipped stone debris.

Using spatial clusters as cases, a table of lithic counts was constructed, and marginal sums of the rows and columns in this table and expected values for each entry calculated. A chi-square value was then calculated for each entry as that value less its expected value, divided by the square root of its expected value resulting in a matrix of scores measuring deviation of observed from expected values. The ANTANA program was then used to perform an SVD analysis of this matrix, computing the singular values and the right and left sets of singular vectors. Singular values can be thought of as the factors accounting for the variance in the Chi-square matrix, or as separate dimensions of variability. Right singular vectors can be thought of as new data values for each variable and left singular vectors as new values for each case. In this analysis, the new data values of each lithic class are scaled by the four singular values accounting for the majority of variance in the data matrix.

The results of this analysis are lithic classes ranked for each of four singular values or dimensions of variability in the data. These results were obtained separately for each of the six Area 1 and 2 survey units. Table 8.3 lists the ranks of lithic classes by vector for each survey unit. Vector 1 accounts for the greatest percentage of variance among spatial associations

Table 8.1. General characteristics of spatial associations of artifacts and features in mesa top survey units.

Unit	N	Mean Area	Mean Density	Percentage FAR	Grst	Ceram	Lithic
1	84	52.53	1.78	79.29	3.16	1.98	15.55
25	74	48.22	2.05	18.29	13.05	12.15	56.49
32	48	42.05	2.10	26.93	18.45	8.29	46.30
50	92	48.86	3.39	15.43	13.29	41.30	29.97
75	128	62.98	11.34	9.83	14.47	7.40	68.28
110	75	43.31	12.75	28.48	13.95	4.06	53.49

Table 8.2. Summary statistics for lithic variables calculated for spatial association in Area 1 and 2 survey units.

Variable	Mean Count per Spatial Association					
Unit	1	25	32	50	75	110
Angular Debris	0.59	2.90	2.19	1.31	1.88	1.81
Bipolar Flakes	0.15	0.09	0.08	0.06	0.20	0.20
Biface Thinning Flakes	0.00	0.06	0.02	0.05	0.22	0.09
Undifferentiated Flakes	1.50	6.62	3.29	2.67	6.23	3.59
Late Stage Flakes	0.37	2.32	1.19	0.73	1.70	1.04
Small Cores	0.12	0.29	0.06	0.05	0.29	0.16
Large Cores	0.03	0.12	0.08	0.11	0.13	0.05
Formal Tools	0.06	0.01	0.06	0.09	0.10	0.09
Utilized Flakes/Debris	0.34	0.17	0.31	0.37	0.57	0.52
Incomplete Groundstone	0.43	2.68	2.14	2.82	2.15	2.36
Complete Manos	0.00	0.00	0.02	0.01	0.01	0.00
Complete Hammerstones	0.06	0.10	0.04	0.08	0.07	0.08
FA Groundstone	0.10	1.20	0.89	1.58	1.15	0.62
Non-carbonate FAR	0.31	2.08	1.36	1.10	1.23	1.32
Number of Spatial Clusters with Lithics	66	74	47	87	128	74

BLANK

PAGE

Table 8.3 . Vector loadings for lithic variables in Area 1 and survey units.

	VECTOR 1						VECTOR 2					
UNIT	1	25	32	50	75	110	1	25	32	50	75	110
SINGULAR VALUES	13.49	18.55	14.97	19.54	30.00	16.52	11.66	17.78	14.97	17.16	23.93	16.09
ANGULAR DEBRIS	0.68	3.98	0.59	-0.18	4.82	-2.73	-1.70	-1.29	-1.16	5.12	-1.80	-2.70
BIPOLAR FLAKES	-0.15	1.03	0.33	-0.03	1.77	-1.70	-3.81	-1.90	-0.53	0.24	1.04	0.25
BIF THIN FLAKES	---	3.00	0.59	-0.19	2.51	-1.07	---	0.33	-1.12	1.03	-0.02	0.68
UNDIFF FLAKES	-1.17	8.45	2.42	-0.21	11.74	-7.34	0.46	0.66	-3.98	5.33	3.97	2.94
LT STAGE FLAKES	-0.82	3.86	1.87	1.00	8.32	-4.42	1.46	-0.35	-2.98	4.67	2.38	2.04
SMALL CORES	-0.35	-0.83	0.46	0.08	0.95	-1.80	0.06	-0.82	-0.92	0.76	-1.81	-1.38
LARGE CORES	13.29	0.65	-13.91	2.74	1.64	-0.91	-0.63	-1.05	-0.80	-0.58	-1.39	0.84
FORMAL TOOLS	-0.12	-3.22	0.09	0.66	1.07	-5.19	-8.53	-3.56	3.93	4.84	-1.66	-14.81
UTIL FLAKES/DEB	-0.52	2.05	-4.27	4.33	1.32	0.48	1.80	-3.09	-0.93	3.15	0.83	1.19
GRNDSTN FRAGS	-1.05	-8.94	-0.83	-3.44	-16.96	10.07	5.13	-6.14	4.19	-7.66	5.29	-2.11
CMPL MANO	---	---	0.20	0.71	-0.05	---	---	---	11.01	1.96	0.29	---
CMPL HAMMRSTONE	-0.26	-2.38	0.24	17.91	1.36	2.12	1.30	-0.96	1.42	-5.00	0.30	-0.36
FA GRNDSTONE	-0.48	-8.49	0.82	-4.17	-18.03	5.82	-3.31	-5.96	3.79	-9.20	6.16	-0.96
NON-CARBON FAR	0.98	-7.64	-0.68	1.73	-6.71	4.08	0.78	14.55	0.00	0.78	-21.73	-3.01
PATTERN	4	1	4	4	1	1	3	2	1	1	2	3

	VECTOR 3						VECTOR 4					
UNIT	1	25	32	50	75	110	1	25	32	50	75	110
SINGULAR VALUES	10.86	14.44	14.19	14.78	17.27	14.79	9.57	13.71	13.44	13.40	15.92	12.27
ANGULAR DEBRIS	-1.42	2.76	2.21	-6.40	7.02	-3.20	-7.64	-1.71	-1.01	9.02	-1.34	6.26
BIPOLAR FLAKES	0.97	-0.58	0.50	1.92	0.81	0.29	-0.48	-0.08	0.26	-0.44	-2.32	-2.29
BIF THIN FLAKES	---	-2.00	1.25	1.99	1.21	-1.03	---	-0.77	0.72	0.12	-2.34	-3.43
UNDIFF FLAKES	-4.30	-3.65	3.82	5.38	0.87	1.17	3.15	-0.24	1.97	0.14	-0.42	-0.94
LT STAGE FLAKES	-1.35	-1.09	2.83	7.26	-0.47	-0.15	3.66	1.65	1.77	-1.09	-0.55	-1.13
SMALL CORES	-2.03	-0.05	-1.33	-0.01	-11.13	-2.39	-1.50	-2.00	1.27	-0.36	-2.35	1.66
LARGE CORES	0.42	3.16	1.74	1.73	-5.77	-0.52	0.76	0.34	0.38	-3.18	10.32	1.85
FORMAL TOOLS	4.91	-7.59	0.40	2.52	-3.49	-1.90	1.91	9.48	-8.67	-0.61	-2.48	-0.48
UTIL FLAKES/DEB	1.36	9.27	0.49	-2.82	-1.68	-0.45	0.11	8.51	0.57	-2.84	8.88	-8.47
GRNDSTN FRAGS	6.99	1.13	-1.25	-0.21	-0.66	-5.76	0.06	-2.89	-3.07	0.39	0.14	1.43
CMPL MANO	---	---	3.52	-3.59	0.12	---	---	---	6.50	-6.79	0.68	---
CMPL HAMMRSTONE	0.21	4.87	0.88	0.79	-8.44	0.14	-1.14	-0.83	-5.04	1.92	-6.48	-0.12
FA GRNDSTONE	3.80	-1.57	0.32	0.10	0.65	-1.66	-1.15	-0.75	-1.15	-1.19	-0.64	-2.97
NON-CARBON FAR	-0.87	0.85	-11.45	-7.54	0.97	12.65	0.72	2.36	2.52	-5.15	-0.29	1.71
PATTERN	1	3	2	2?	4	2			3		3?	

within each unit and can usually be attributed to relationships between those items of highest frequency in the data matrix; Vector 2 accounts for a lesser amount of variability, and so on. Factors structuring Vector 1 for one survey unit may account for a different vector for another survey unit; that is, the underlying causes of lithic content in spatial associations, while similar for all survey units, may differ in strength among units. Given the continuous discard of artifacts over the long-term and repetitive strategies of land use, vector loadings should be similar among survey units.

Vector Interpretations

Several major patterns in the lithic content of spatial associations have been identified from the SVD analysis and indicate generally similar histories in the use and reuse of the West Mesa landscape. Each of these patterns consists of extreme and opposite loadings for two sets of variables. This opposing relationship represents a redundant structure or configuration of lithic tools and debris in spatial associations, the underlying "causes" of which can be interpreted. Each pattern is first described and interpretations are offered. Other sets of weaker relationships between chipped stone and groundstone tools and debris are apparent for some individual survey units. Lithic variables contributing to these patterns may reflect occupational histories of individual units that can be attributed to differences in functional settlement types--that is, to differential selection of portions of the area for specific uses.

Patterns of Artifact Visibility and Tool Use, Discard, and Recycling

The strongest patterns represented by vector loadings of lithic variables contrast (1) chipped with groundstone, (2) non-carbonate FAR versus groundstone fragments, (3) formal tools versus flakes and flake tools, and (4) large cores and hammerstones versus either flakes, fire-altered groundstone, or angular debris. Each vector accounts for a portion of the variance among lithic assemblages as measured by singular values (Table 8.3). Patterns of lithic variability are described and interpreted below.

1. Groundstone Versus Flakes and Debris Vectors

The set of vector loadings for lithic variables, which characterizes all units, contrasts groundstone fragments, fire-altered groundstone, and non-carbonate FAR, many of which are unidentifiable types of groundstone, with undifferentiated flakes and angular debris, the five classes accounting for a majority of items in lithic assemblages (Table 8.3). For example, in the case of Unit 75, spatial associations are most variable with respect to proportions of flakes and groundstone in assemblages. Groundstone fragments, fire-altered groundstone, and non-carbonate FAR share extreme negative ranks on Vector 1 (which accounts for the largest share of variability among spatial associations in Unit 75), while undifferentiated flakes, late stage flakes and angular debris are the highest positively ranked items on this vector. Figures 8.1, 8.2, 8.4, 8.5, and 8.6 illustrate this pattern on Vector 1 for survey units 25, 75, and 110. This pattern is also present in Vector 2 for units 32 and 50 (Figures 8.8 and 8.10), and Vector 3 for Unit 1 (Figure 8.7).

A pattern of variability in the frequency of groundstone and chipped stone could be construed as indicative of the fact that some places were used more often for processing with groundstone and others for activities involving chipped stone tool manufacture and use. This interpretation infers that selection of places at which either tool class was used involved the exclusion of locations containing the other. Repeated use and continual discard of chipped and groundstone on the West Mesa for as many as 10,000 years renders this inference unlikely; that is, since most surface distributions represent composites of artifacts and features from successive occupations throughout the period of prehistoric use of this area, most of them will not represent episodic behavior in a direct way. Spatial associations are instead viewed as deflated, overlayered composites of many episodic distributions resulting from repeated events that may be widely separated in time.

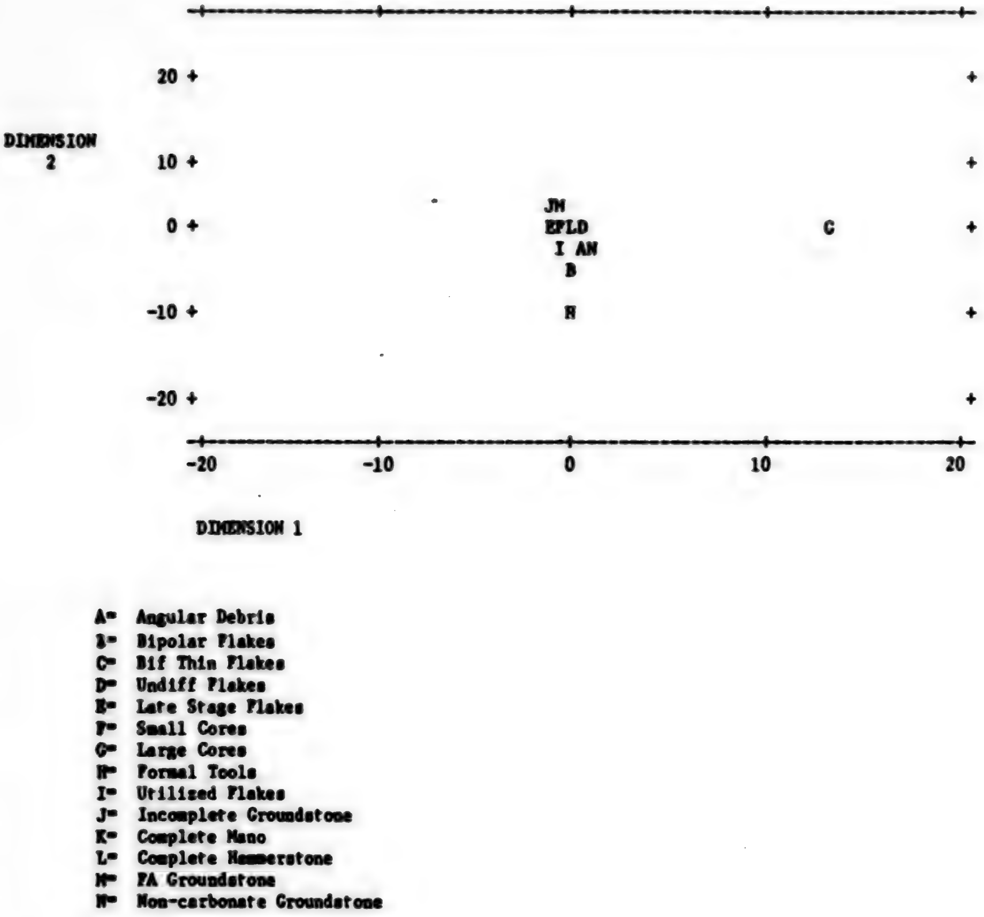


Figure 8.1. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 1

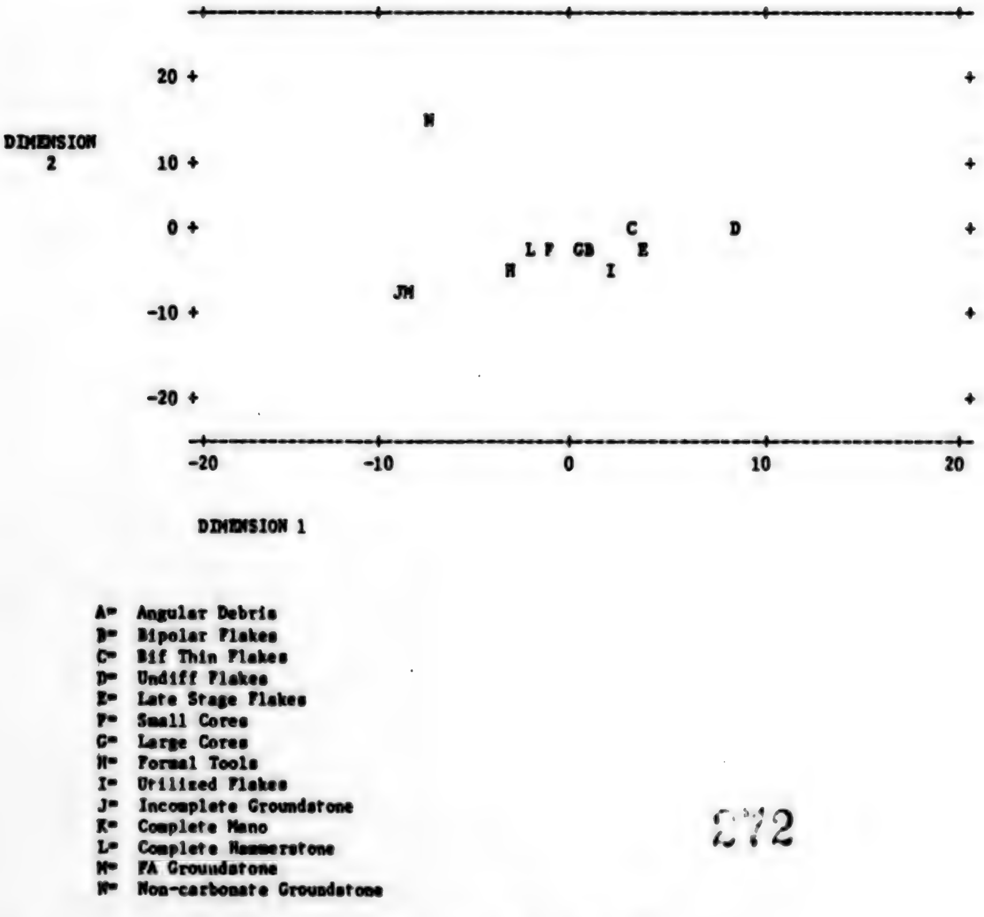
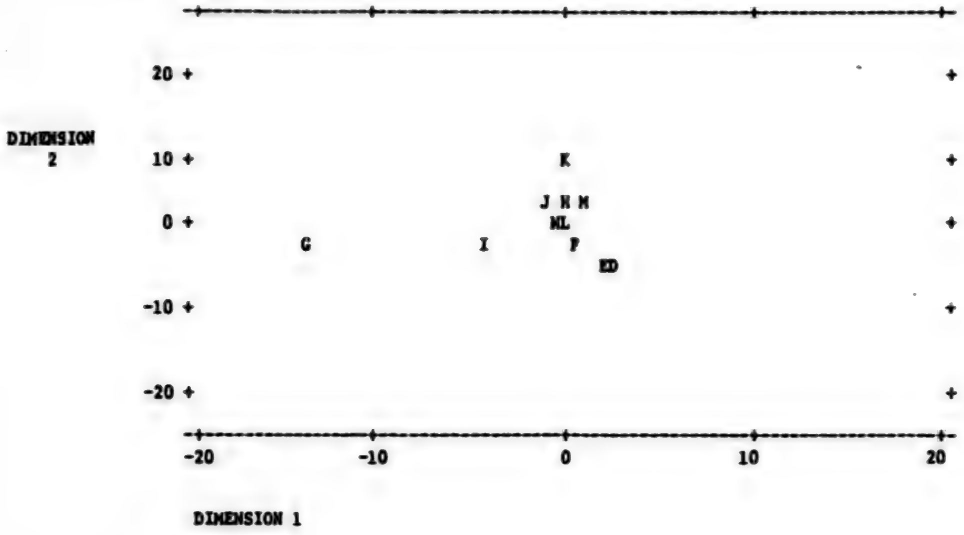
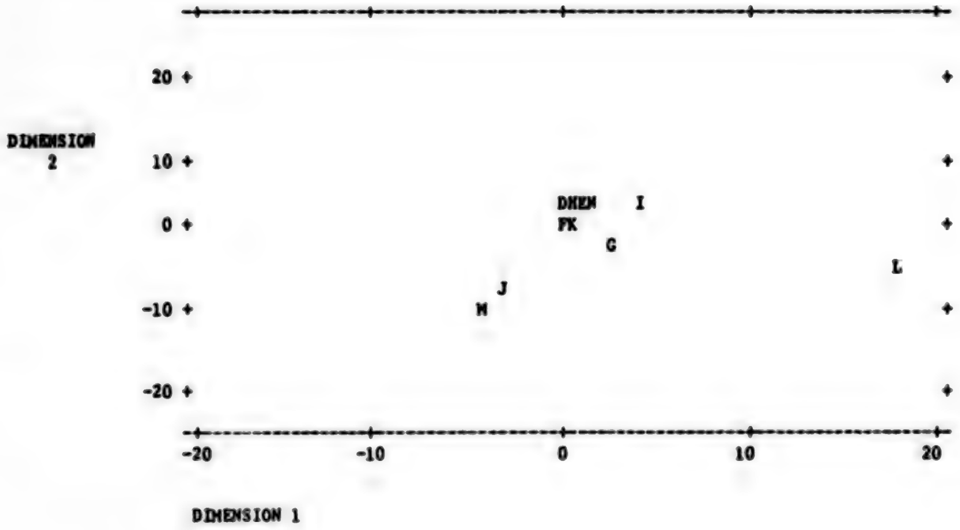


Figure 8.2. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 25



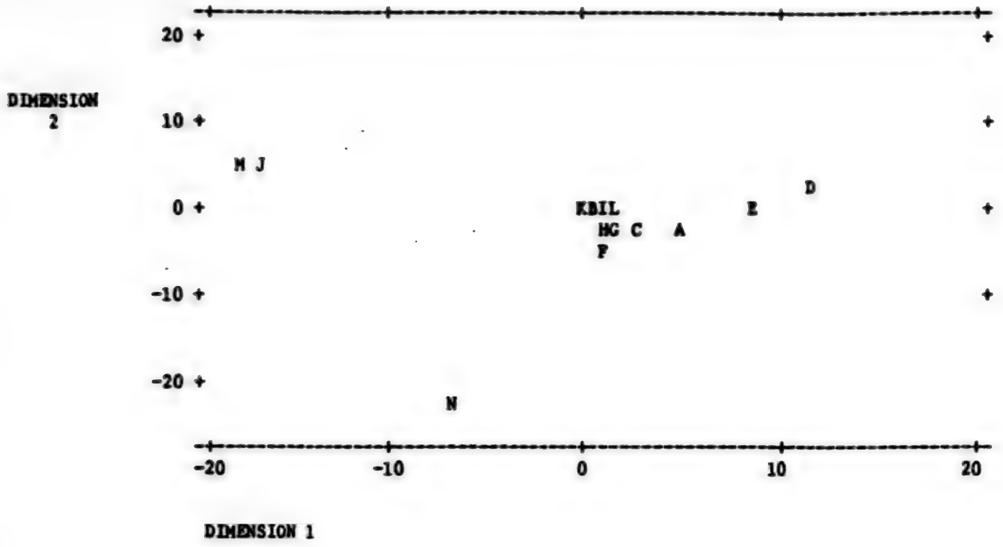
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.3. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 32



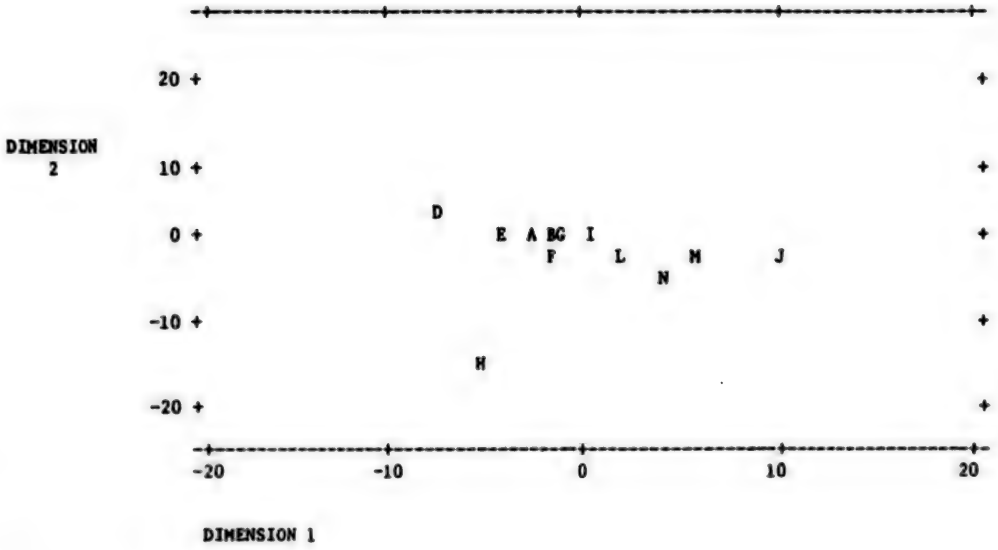
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.4. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 50



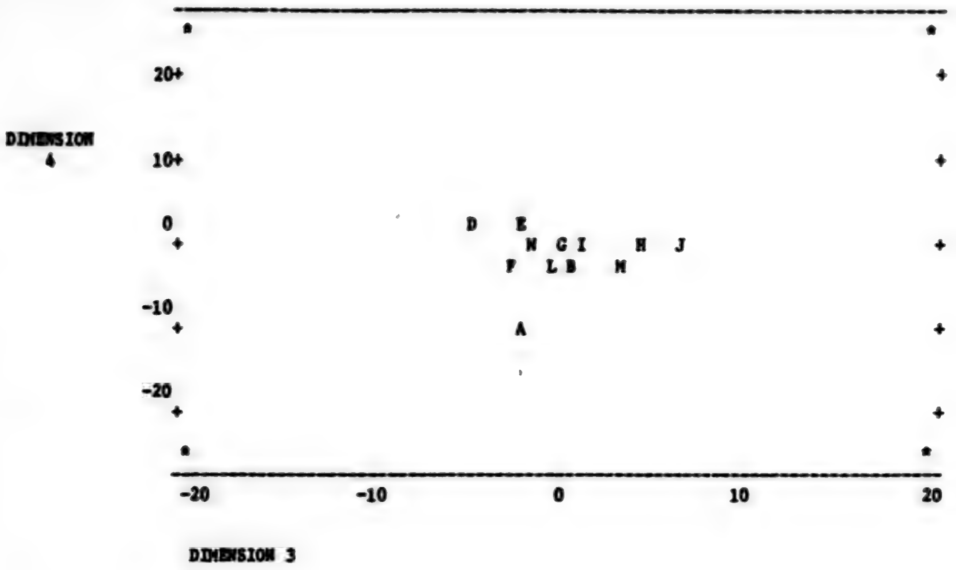
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.5. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 75



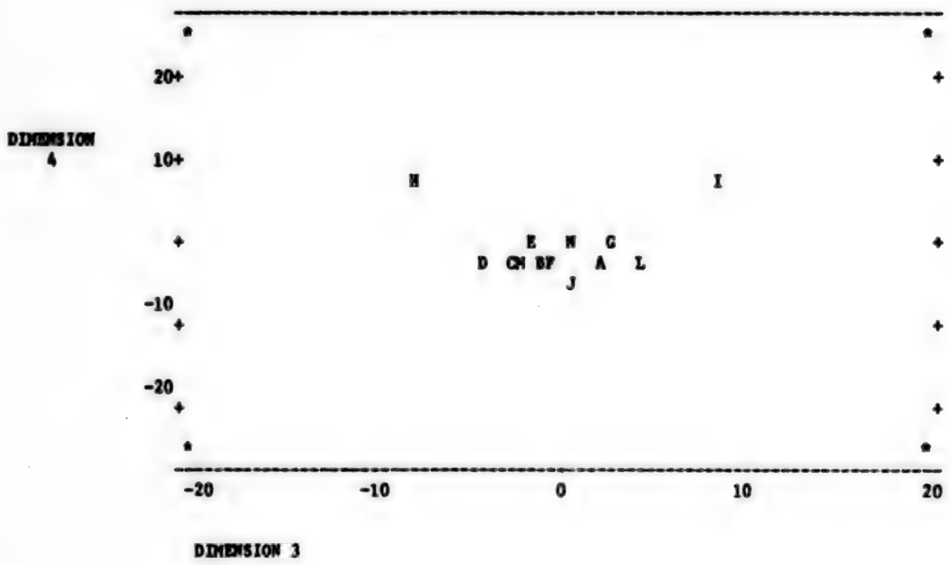
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.6. PLOT OF SVD DIMENSIONS 1 AND 2 FOR SURVEY UNIT 110



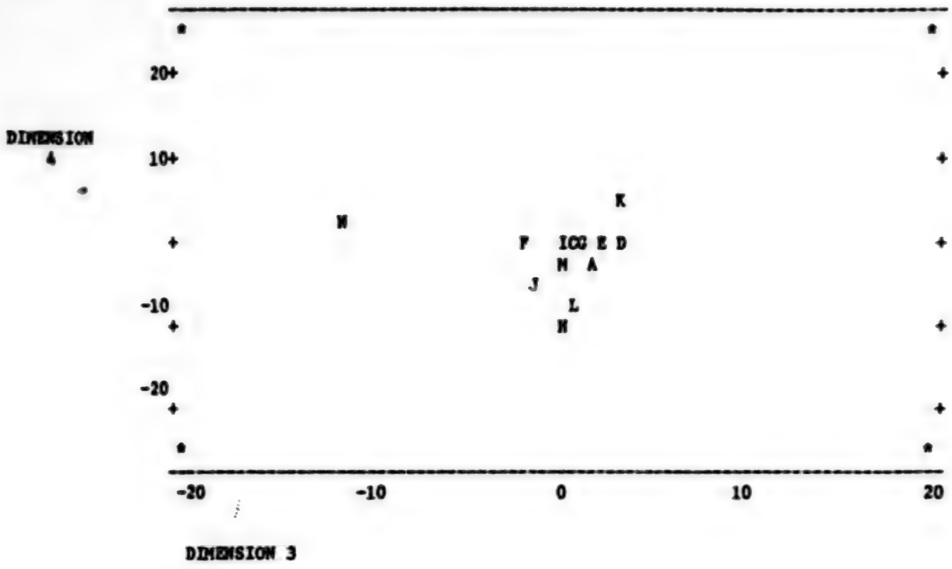
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.7. PLOT OF SVD DIMENSIONS 3 AND 4 FOR UNIT 1



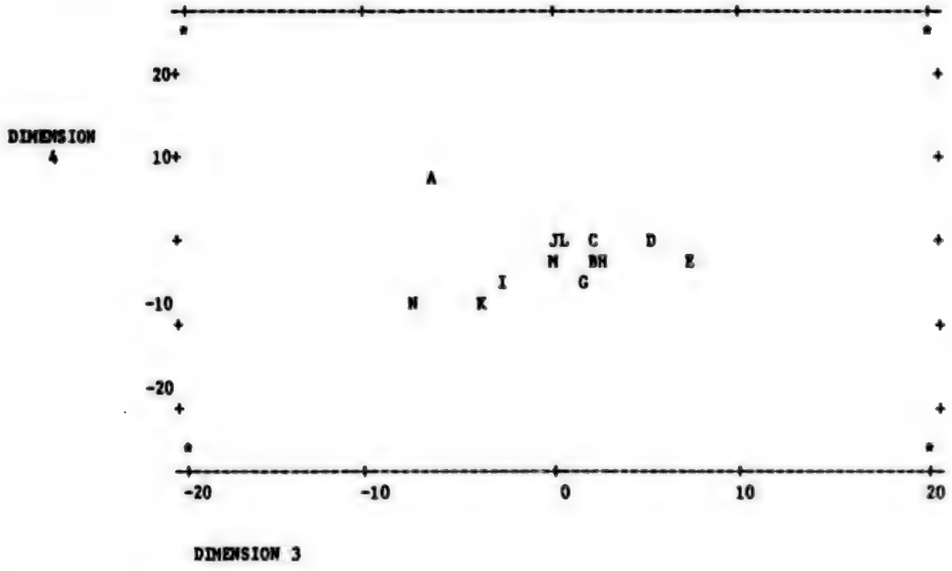
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.8. PLOT OF UNIT 25 DIMENSIONS 3 AND 4



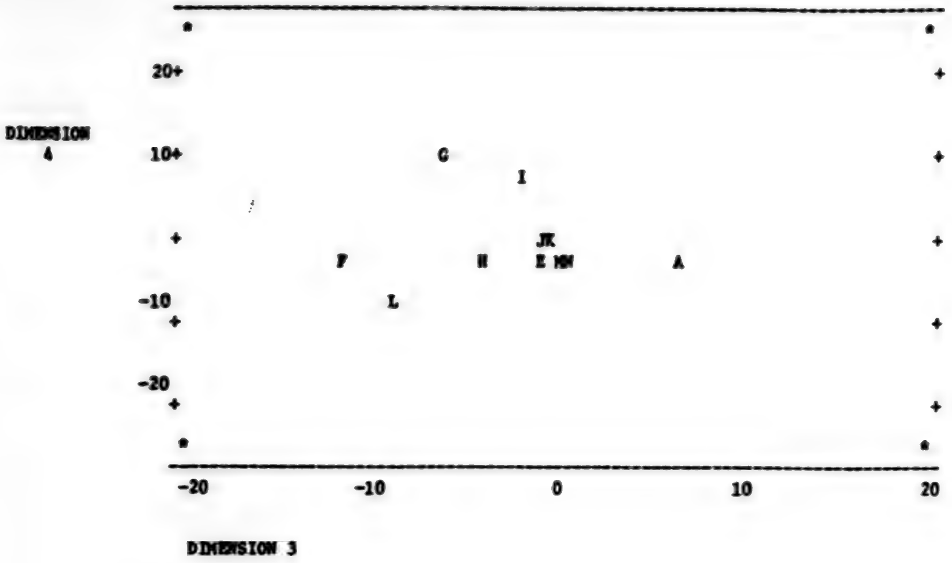
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.9. PLOT OF UNIT 32 DIMENSIONS 3 AND 4



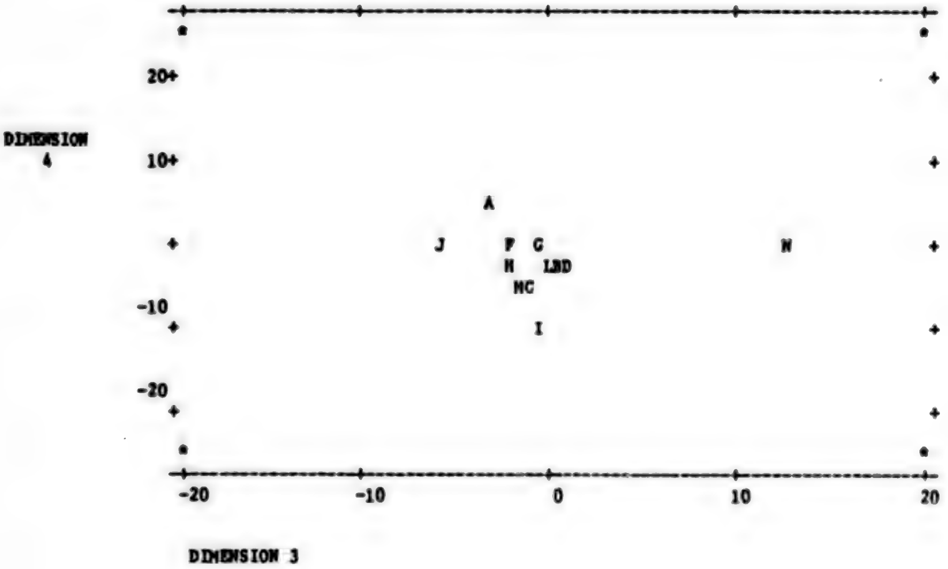
A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.10. PLOT OF UNIT 50 DIMENSIONS 3 AND 4



A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.11. PLOT OF UNIT 75 DIMENSIONS 3 AND 4



A= Angular Debris
B= Bipolar Flakes
C= Bif Thin Flakes
D= Undiff Flakes
E= Late Stage Flakes
F= Small Cores
G= Large Cores
H= Formal Tools
I= Utilized Flakes
J= Incomplete Groundstone
K= Complete Mano
L= Complete Hammerstone
M= FA Groundstone
N= Non-carbonate Groundstone

Figure 8.12. PLOT OF UNIT 110 DIMENSIONS 3 AND 4

While not discounting that activities which involved the use of differential amounts of groundstone and chipped stone did occur in the past, the percentages of groundstone and all chipped stone types increase together in spatial clusters and can be shown to be significantly correlated (alpha = 0.0001). This vector may not, therefore, indicate a simple difference in the proportion of chipped stone and groundstone in spatial clusters. A far more basic difference between chipped stone and groundstone is item size. As Table 8.4 indicates, groundstone fragments are significantly larger than chipped stone flakes and debris. Factors structuring a groundstone versus chipped stone flake and debris vector may therefore be related to factors influencing the differential archaeological discovery of large and small items at places, rather than to the functional attributes of chipped stone and groundstone. One factor influencing our perception of the archaeological record as such is differential archaeological visibility as determined by post-depositional erosional processes.

Recent experimental research on the effects of natural aeolian processes on archaeological remains suggests that a mechanical interpretation of the differential visibility and discovery of artifacts may be warranted. Wandsnider (1986:9), in the course of experimental studies in sand dunes, has found that artifacts which are first buried by windblown sand are small and thin, the percentage of artifacts that is buried being positively related to mean artifact base area. Looking at burial and exposure rates, Wandsnider (1985:6) also found that a higher proportion of small artifacts at experimental stations exposed to the prevailing wind direction where deposition was occurring were buried. Increased wind velocity resulting in deflation at experimental stations resulted in the re-exposure of moderate and small sized artifacts. These results suggest that the differential burial of smaller, thinner artifacts can introduce a size bias into perceived surface assemblage content due to post-depositional geomorphological and mechanical processes (Baker and Dunnel 1985; Wandsnider 1985), and that such effects become more pronounced through time.

The strong associations between geologic units and spatial patterns in artifact frequency observed by Pierce and Durand during their study of archaeological surface distributions (1985) on the West Mesa may be attributable to archaeological visibility. Pierce and Durand (1985:6) found linear patterns of high artifact frequencies following low scarps traversing their Santa Teresa study area, with greatest artifact densities on the high points between scarps. Broken down by artifact class, groundstone concentrations were found to be restricted to areas of low scarps, while chipped stone occurred

Table 8.4. Distribution of groundstone fragments, angular debris and undifferentiated flakes by size class.

	Size Class			
Artifact Class	1-30 mm	31-60 mm	61-100 mm	>100 mm
Undifferentiated Flakes	4765 71.75	1822 27.44	54 0.81	0 0.00
Angular Debris	1614 49.69	1504 46.13	125 3.85	5 0.15
Groundstone Fragments	488 17.13	1366 52.24	666 25.47	135 5.15

more ubiquitously but with concentrations on the higher ground between scarps.

These results suggest topographic differences related to depth of sand cover as indicated by elevation (areas of higher elevation contain deflated surfaces and those of lower elevation depressions where sediment is accumulating) and that size-sorted assemblages produced through aeolian processes may only be detectable through the intensive inspection of relatively large areas. Lacking appreciable relief, survey units in Areas 1 and 2 are difficult to assess for this kind of topographic variation. Although depth of sand cover over the Pleistocene paleosol does vary in Areas 1 and 2, it cannot be readily discerned through examination of elevational differences in a 400 x 400 meter area. Survey units do not include both ridges or uplands and deflation basins since the size of an area necessary to detect this scale of topographic change is much larger than 400 x 400 meters. Optimally, survey units 1 kilometer on a side, or even larger, would be needed to examine an elevational gradient along which the artifact bearing interdunal surface would be differentially exposed.

Since depth of sand cover, and conversely the depth of a compact substrate from the surface, have been shown to differentially affect the visibility of different sized items (Baker 1978; Beckett 1980; Wandsnider 1986), archaeological visibility is also potentially linked to microtopographic variation, such as that encompassed by exposed versus unexposed portions of interdunal surfaces or interdunal/dune borders versus central interdunal surfaces. Microtopographic variation at this scale was not documented by this project.

Although assessing a size-related interpretation of the groundstone versus chipped stone vector is precluded by lack of thorough environmental documentation at this point, such an interpretation cannot be dismissed. To further pursue this question, the relationships between artifact size, elevation, and exposure for a portion of the West Mesa will be described in the final section of this chapter through the analysis of spatial associations from a larger surface than examined here.

2. Non-carbonate Fire-altered Rock Versus Groundstone Fragment Vectors

All units with the exception of Unit 1 are described by a vector with extreme loadings for groundstone fragments on one end and non-carbonate FAR on the other (Table 8.3). Vector 2 illustrates this pattern for Units 25 and 75, while Vector 3 could be similarly interpreted for Units 32 and 110 and possibly Vector 3 for Unit 50 (Figures 8.2, 8.5, and 8.9 - 8.12). This pattern stems from the fact that places containing non-carbonate FAR lack groundstone fragments and can be interpreted here as the result of the recycling of groundstone into hearth and roasting pit elements. Figures 8.2 and 8.12 illustrate this relationship on Vector 2 for Units 25 and 75, and 8.9, 8.10, and 8.12 on Vector 3 for Units 32, 50, and 110.

It is interesting that Unit 1, which straddles the West Mesa scarp where the caliche substrate outcrops, is the only unit in which proportions of groundstone and non-carbonate FAR rock are not inversely related. This relationship between FAR and non-carbonate FAR is obtained for all other survey units, pointing to a potentially high degree of artifact recycling in general on the West Mesa and to the fact that some places may have experienced recycling to the degree that a majority of rock suitable for use in hearth or roasting pit features was recycled.

3. Formal Tools Versus Utilized Flakes and Debris Vectors

Formal tools rank opposite utilized (and sometimes unutilized) flakes and angular debris on Vector 2 for Units 1 and 110 (Figure 8.1 and 8.12), on Vector 3 for Unit 25 (Figure 8.7) and Vector 4 for Unit 32 and possibly Unit 75 (Figures 8.8 and 8.12). This vector represents the contrast between places where formal tools are discarded (but not necessarily utilized), but which lack utilized flakes, versus those places where flakes and angular debris were probably both used and discarded.

Use of flake tools on the West Mesa necessitates the planned importation of materials in the form of flakes or cores. Given raw material importation, places where flake utilization has taken place can be thought of representing the successful termination of a core-carrying strategy. In contrast, a strategy switch would be indicated by formal tool discard. Discard of viable formal tools suggests an anticipated change in tool requirements, or a "strategy change" for tool use. Formal tools classed as complete or with a completeness code of greater than half make up the majority of unifaces, bifaces and projectile points in this analysis and are, therefore, either viable or recyclable tools. A reclassification of formal tools into complete, recyclable, and unusable categories and reanalysis of spatial associations would be needed to further examine the notion of a strategy switch.

Since a "switch" in tool using strategy can be modeled as occurring at field locations in the case of unanticipated events, or at residences where gearing up for planned activities takes place, this vector cannot necessarily be interpreted as representing a contrast in the lithic content of functionally distinct locations, e.g. residences versus field extraction sites.

4. Large Cores and Hammerstones Versus Chipped Stone and Groundstone Debris Vectors

Large cores or complete hammerstones have extreme ranks on Vector 1 for Units 1, 32, and 50 (Table 8.3, Figure 8.1, 8.3 and 8.5). Complete hammerstones, small and large cores have similar extreme scores on Vector 3 for Unit 75 (Figure 8.11). The scores of other lithic classes on these vectors are not close to those of large cores or, in the case of Unit 50 hammerstones, indicating that such items may not occur in close proximity to other tools or debris. If these items do occur in areas of low artifact density, it may be that their larger size enables a higher degree of archaeological visibility for these items, enhancing their chances of being found by subsequent inhabitants of an area and further reused. Thus, as with the chipped stone and groundstone dichotomy previously described, this pattern may represent the affects of natural processes. Items with vector scores relatively close to those of large cores or complete hammerstones are, however, quite small offering negative evidence for this interpretation.

Large cores and complete hammerstones are also reusable items and as such are likely to be cached in areas where as on the West Mesa raw materials are unavailable. Methods for identifying cached goods and caching locations in the archaeological record are, at present, in a developmental stage, and one attribute of caching locations proposed by Schlanger (1986) is that the locations of cached materials are marked on the landscape sometimes using rock cairns. On the generally featureless West Mesa landscape, mounded accumulations of FAR and ash stained soil, some incorporating hammerstones and groundstone fragments, may serve this purpose. However, differences in vector scores between large cores, hammerstones, and other artifact classes indicate that they are not systematically associated with debris such as FAR rock and groundstone at places that could have been the focus of feature reuse.

Instead, with the exception of Unit 1, tool classes with vector scores closest to those of cores and complete hammerstones include utilized flakes and debris. A pattern in which large cores and hammerstones are discarded or cached at places where flakes are manufactured and utilized may indicate that they are intentionally left in areas where activities requiring flake tools are anticipated in the future. A strategy of leaving viable core material behind at field locations may serve to systematically furnish a general area with raw materials and tools for tool manufacture. In this case, markers are not necessary because relocation of core material or hammerstones could be accomplished by searching the vicinity of known activity areas. "Known" in this sense might not mean known by previous use, but rather by "scouting out" available materials left by previous inhabitants of the area.

Schlanger (1986:7-9) has termed this type of caching "load exchange" to denote tools that are cached at the point of their use on the way from residences. In load-exchange caching, tools and raw materials packed to the field site are replaced with collected resources on the return trip to a residence:

> The tools are left at or very close to the place at which they are used. They are not placed there as part of some advanced planning, however, but accumulate over time during repeated occupations of the location. In this way, such caches are equivalent to what Binford has called "site furniture" (1978:339-340, 1979:257): "items that go with the place" (Binford 1978:339). The places

220

> themselves--nut tree groves, marshes, hunting stands--are stationary, though they may vary in productivity through time, so that relocating caches presents no difficulty.

Schlanger's (1986) review of hunter-gatherer caching behavior identifies tools involved in "load exchange" caching as generally heavy or difficult to transport making it handy to leave these items at repeatedly visited sites rather than to return them to a main residence every time the field location was visited. Most practitioner's of "load-exchange" caching were mid-latitude hunter-gatherers including the Surprise Valley and northern Paiute. The provisioning avenue for hand stones used cracking mongongo nuts by the Dobe San may be analogous to that by which complete hammerstones and large cores may have functioned in load-exchange caching on the West Mesa (Lee 1979:152-153):

> The nut groves are located on sandy soils, which lack natural sources of calcrete for cracking stone. Through the generations, pairs of these stones have become distributed by the !Kung throughout the nut forests of the Dobe area. When making a new camp in the groves, one simply picks up the stones from nearby abandoned campsites. It is only occasionally necessary for a woman to carry her own cracking stones from one camp to another.

Patterns of distribution of large quartzite bifacial cores (Biface 1's) which suggest a similar strategy have been described by Ebert (1986) from southwestern Wyoming. These cores were found to be distributed evenly across the landscape in a spacing pattern which was attributed to intentional caching of cores for for future use.

Unit-Specific Patterns

The SVD analysis results also include a number of weaker patterns characteristic of fewer or individual units. These include high scores for angular debris on Vector 4 for Units 1, 50, and 110 (Figures 8.7, 8.10 and 8.12). Angular debris scores do not consistently contrast with those of another artifact class possibly because of the variable conditions for generation of angular debris, for example, either by reduction of core material with unpredictable fracturing properties such as granular volcanic materials or by chipped stone and groundstone tool recycling.

Producing tools from previously deposited cores and artifacts--that is, lithic recycling -- relies on core materials with shapes and sizes which could be relatively inefficient for flake removal resulting in the generation of more angular debris than tool manufacture with prepared cores. Comparing the Keystone Dam Site areas on the edge of the Franklin Mountains where raw material is relatively abundant to West Mesa assemblages, it is the case that the angular debris to flake ratio for the West Mesa chipped stone assemblage is more than twice as high as that of most Keystone Dam assemblages (0.58 compared with an angular debris to flake ratio ranging from 0.08 to 0.36 for Keystone Dam Sites 33 and 34 assemblages). This finding suggests that tool recycling may have contributed to higher angular debris frequency on the West Mesa.

Angular debris, hammerstones, and incomplete groundstone rank together on Vector 4 for Unit 1 with late stage flakes on the opposite end of the vector. This pattern may represent a contrast between general recycling and chipped stone tool production versus tool maintenance using prepared core material. In Unit 110 angular debris, cores and groundstone fragments are oppositely ranked with all flakes indicating a similar pattern. In Unit 50, angular debris is distantly ranked from almost every artifact class, with groundstone fragments and complete hammerstones having the nearest positive scores.

Spatial associations in Unit 25 are characterized by high ranks for formal tools and utilized flakes and debris on Vector 4 (Table 8.3, Figure 8.8). Groundstone fragments, angular debris, and small cores are negatively ranked on the other end of Vector 4. Unit 25 is the only unit for which formal tools and utilized flakes have extremely high and similar scores on a vector. Vector 4 contrasts tools with debris, or lithic garbage, indicating differences in the patterns of discard for each. A functional dichotomy between residences or base camps where debris of all sorts accumulates versus field locations where tools are used and discarded, but not manufactured, could therefore be represented by Unit 25 spatial associations.

A similar functional dichotomy but one incorporating a core-caching strategy, could be suggested for Unit 75 assemblages. Large cores and utilized flakes rank high in contrast to low ranks for flakes, angular debris, and complete hammerstones on Vector 4 for Unit 75 (Table 8.3, Figure 8.11). This pattern may indicate the contrast in lithic content between places where flake tools were manufactured and used, and their future use anticipated through cone discard, versus places where flake and other debris is produced--a contrast between field locations where only flake tools required for immediate utilization are produced and discarded and residences where tools and debris are discarded.

SVD Analysis Conclusions

A consistent pattern resulting from the analysis of archaeological surface distribution content near the West Mesa scarp is one that contrasts the occurrence of chipped stone and groundstone. The suggestion made here is that this contrast stems from the size-sorting action of aeolian processes on the mesquite coppice dune topography of the West Mesa, an action which results in the differential visibility, and therefore, discovery of artifacts. With this interpretation, the surface archaeological record is not viewed as a distorted representation of past activity areas and occupations but, rather, as the summed record of discard events as they interact with natural depositional and post-depositional processes.

Interpretation of behavior from this record, including field identification of the "sites" of past activities, cannot be accomplished directly for several reasons. First, activities cannot be reconstructed on the premise that spatially associated materials were used together in the past, because behavioral (cultural) processes themselves serve to disassociate items which were used together and associate other items which were not. On the West Mesa landscape, these processes include the recycling of groundstone into hearth features, which is observed in all areas except those where the caliche substrate is readily accessible. Another repetitive behavioral process interpreted from the West Mesa lithic data includes the discard of core material, and in some places hammerstones, in such a way that over a long time period the landscape is furnished with these tool classes in most places. Reuse and recycling of core materials, hammerstones, and groundstone artifacts results in the repetitive, short-distance movement of these items. Behavioral processes can, thus, serve to associate in a very systematic fashion items which were never used together in the past. In addition, the differential occurrence of formal and flake tools suggests that, if flakes were discarded at the sites of their manufacture or use, formal tools were not. The discard of formal tools may be dictated, then, by anticipated events and not directly by the activities in which they were used with the result that they are almost never used in the same activities as the artifacts with which they are deposited.

Finally, natural depositional and post-depositional processes serve to make artifacts differentially visible and therefore available while artifact recycling and reuse is ongoing. Thus, systemic interaction between cultural and natural processes occurs posing yet another disjuncture in the continuum between activities and their archaeological equivalents--a continuum which conventional methods of "site" interpretation seek to reconstruct.

This is not to say that spatial associations of artifacts and features whether on the ground surface or in stratified deposits (see Chapter 2 for a discussion of the potential research value of archaeological composites in each context) carry no meaning. They inform about the history of landscape use and reuse by systems and portions of systems. In the next section of this chapter, the artifact content of surface distributions is examined for associational patterns which result from the above interpreted processes of tool discard and reuse. A final section of this chapter examines the relationships between artifact size, elevation, and exposure.

ANALYSIS OF SPATIAL ASSOCIATION CONTENT

In the first section of this chapter, relationships among lithic tool and debris classes were identified within survey units in Survey Areas 1 and 2 located near the West Mesa scarp. Relatively compact surface distributions of archaeological material were devised by clustering the x and y spatial coordinates of artifact and features in each of the 400 x 400 meter survey units. Survey Units 1, 25, 32, 50, 75, and 110 contain from 48 to 128 such spatial associations the content of which was amenable to SVD analysis.

Survey Area 3, on the interior mesa top, contains five survey units, each 800 x 800 meters on a side--Units 2, 3, 21, 45, and 48--which were intensively surveyed during Phase II of the NHLEP. Since Units 2 and 3 are contiguous they were combined into a 1600 x 800 meter surface for which spatial associations were produced. The number of spatial associations in Area 3 survey units ranges from 120 to 551. Analyzing relationships between lithic artifact classes with such a large number of cases proved prohibitive using the SVD technique. For this reason, another method of comparing the content of spatial associations was sought.

Methods

In all, 1,796 artifact/feature associations were obtained through clustering the spatial coordinates of the plotted surface material from all mesa top units. The content of all associations was compared for indications of differences in function and history of use between areas on the West Mesa by means of a hierarchical cluster analysis. This analysis uses the spatial associations as cases and Chi values for the lithic tool and debris classes defined in the previous section of this chapter as variables. The algorithm chosen to compute the distance between clusters was Ward's method, in which the distance between two clusters is the sum of squares between the two clusters added up over all variables (SAS Institute Inc. 1982:423). A numerical index, the cubic clustering criterion (CCC) was then used to aid in determining the number of clusters requested. The CCC is an approximation of the expected value of the within-cluster sum of squares (SAS Institute 1982:419-420). Using the CCC to delimit number of clusters, 11 groupings or clusters of spatial associations were obtained.

The results of this analysis enable comparison of lithic assemblage composition among surface distributions. The associated features and ceramic content and the general spatial attributes of associations are compared independently among clusters as well. If different modes of tool importation, manufacture and use, and container use are implemented at functionally distinct locations, residences versus field locations, for example, some correspondence between patterning in composite ceramic and lithic assemblage content is expectable. Also, distributions containing similar lithic assemblages may or may not include ceramics. If ceramic abundance and vessel form aids in interpreting the compositional histories of clustered assemblages then those assemblages in the group which lack ceramics might be more easily interpreted.

This sort of analysis can be accomplished using ceramic types and vessel attributes as "baseline" data against which to compare lithic tools and debris. This was not done with the West Mesa assemblage data for several reasons, the first being that approximately 75 percent of all sherds recorded by the NHLEP were unspecific El Paso Brown. Since attributes of vessel form such as rim diameter and rim eversion, which inform about vessel size and shape, can only be measured from rim sherds, using ceramics as supportive rather than baseline data, was the option chosen in this analysis of the West Mesa artifact clusters. In addition, areas of high artifact density containing the greatest variety of ceramic types were systematically deleted from the portion of the land exchange sampled by the Phase II intensive survey so that these areas could be monitored by the BLM Las Cruces District until such time appropriate mitigation measures for high density areas containing structures were taken. As a result, only about 8 percent of the ceramics documented by the Phase II survey are other than El Paso Brownware and decorated types are absent from most spatial associations. Lacking data on associated ceramic types and vessel form, classes of lithic tools and debris are compared among assemblages keeping types of ceramics and features in spatial associations as independent categories of information that can be compared among groups of similar lithic assemblages.

Lithic, Ceramic, and Feature Content of Grouped Spatial Associations

The 11 groups of surface distributions obtained by clustering the lithic classes tabulated for spatial associations can be compared for differences in amount of core reduction as measured by numbers of late stage and biface thinning flakes, patterns tool and debris discard, degree of flake utilization and groundstone utilization, and recycling. The frequencies of associated ceramics, carbonate FAR, and features each provide other independent evidence for interpreting the historical composition of clustered surface distributions. Table 8.5 lists the mean counts per cluster of lithic tool and debris classes, ceramics and of the size (square meters) and item density (number of items per square meter) in spatial associations in each cluster. Cluster groupings are described below. Table 8.6 compares the proportions of spatial associations and features in each cluster in different periods and phases.

Cluster 1. On the average more carbonate FAR is present in associations in Cluster 1 than are artifacts possibly indicating processing without the need for chipped stone or groundstone implements. Undifferentiated flakes and angular debris make up a majority of items in lithic assemblages but flake utilization is extremely low as is the frequency of formal tools. Groundstone is also present in fragmentary and recycled form in extremely low frequencies. With respect to period and phase assignments, about 72 percent of the associations in Cluster 1 fall into the Unspecific Lithic category. Fewer than expected (when compared to the distribution of all associations in period and phase categories) numbers of associations in this cluster fall in Archaic and Formative Lithic categories (Table 8.6), since assignment to these latter categories is based on the presence of projectile points in assemblages and Cluster 1 assemblages lack high frequencies of formal tools. Mean ceramic counts are relatively low as well for this cluster. Excavated features in Cluster 1 (Table 8.7) include Unit 48NW, Feature 5, a possible pit structure, two pit structures in Unit 45SE, Features 2 and 13; a pit structure or large pit in Unit 45SW, Feature 3 (which is located adjacent Feature 13 in Unit 45SE), and a shallow pit/hearth in Unit 48NW, Feature 6.

Cluster 2. Assemblages in Cluster 2 have high frequencies of non-carbonate and carbonate FAR but relatively low frequencies of chipped stone tools and debris. Carbonate FAR [burned caliche] was not included in the cluster analysis and is listed in Table 8.5 as an independent data set. With the exception of Cluster 11 which includes only three assemblages, mean non-carbonate FAR counts are the highest of all clusters. Much of the noncarbonate FAR is sandstone and volcanic rock (Table 8.8) and is probably recycled groundstone. Since much of it is also relatively large (Table 8.9), high frequencies of FAR are not caused by prolonged recycling or by weathering of already fragmented rock each of which would tend to result in proportionally more small pieces of rock in assemblages.

Moderately high frequencies of late stage flakes also are indicated for this cluster pointing to later stages of core reduction possibly due to core recycling. Most spatial associations in Cluster 2 are classified as Unspecific Lithic, and average ceramic counts are low (Table 8.6). Sixteen of the 37 features associated with Cluster 2 assemblages (Table 8.6b) are accumulations of FAR lacking subsurface staining. An additional 9 features appear to be pits from 50 to 150 centimeters in diameter. Excavated pits-- Unit 45SE, Features 4, 14, and 18 and Unit 3NE, Feature 1--are interpreted as hearths and are associated with variable amounts of FAR which is scattered around the surface of these features rather than contained within them.

Cluster 3. Extremely low overall densities of material are present in distributions in Cluster 3 with little fire-altered groundstone or FAR present in assemblages. Though mean number of utilized flakes is low, Cluster 3 contains a relatively high ratio of utilized edges to number of utilized items (Table 8.10). Cluster 3 contains higher than expected numbers of associations in the Unspecific Lithic and Late Ceramic categories given the overall frequencies of associations in period and phase categories (Table 8.6). A high frequency of large cores and moderately high frequencies of small cores distinguish this cluster. Very few features belong to associations in this cluster and include an ash stain lacking FAR and a pit less than a meter in diameter with associated FAR.

234

Table 8.5. Mean lithic tool and debris counts for clustered spatial associations.

	ANGDEB	BIPFLK	BFTFLK	UNDIFFLK	LTSTAGE	SMCORE	LRGCORE	FORMTOOL	UTILFLK	GSINCMPL	CMPMANO	CMPHMST	GSFAR	NONCBFAR	CARBNFAR	CERAMICS	AREA	DENSITY
1	1.42	.14	.03	2.45	.76	.04	.02	.002	.15	.94	0	.01	.24	.32	9.14	2.33	50.09	8.31
2	1.41	.05	.04	3.14	1.01	.07	.05	.03	.26	.15	.01	.09	.59	3.89	12.28	2.68	46.10	6.59
3	1.30	.03	.01	2.29	.67	.26	1.13	.01	.32	1.26	0	0	.35	.81	8.62	2.10	58.03	1.29
4	1.31	.03	.07	2.47	.99	.07	.01	.01	1.41	1.00	0	.01	.19	.37	8.12	1.11	57.63	1.58
5	1.35	.04	.03	2.13	.47	.26	.01	.01	.25	4.80	0	.01	1.70	.85	6.75	5.87	38.88	9.17
6	2.39	.38	.06	5.45	1.42	1.42	.01	.01	.79	2.08	.01	.04	.21	1.08	8.89	3.45	52.30	1.60
7	1.29	.06	.06	1.20	.57	.20	.10	.02	.37	1.76	0	1.18	.42	.49	8.69	3.06	46.58	1.63
8	1.70	.38	.09	4.23	1.23	.32	.06	1.15	.70	1.47	0	.02	.49	1.21	10.57	2.63	60.19	2.32
9	9.23	1.17	1.83	27.01	8.44	.45	.17	.14	1.53	3.87	.01	.18	.73	1.94	11.25	3.51	38.74	3.19
10	3.34	.07	.30	5.09	1.26	.13	.09	0	.65	2.91	1.09	.09	1.04	1.35	10.08	9.34	34.56	2.05
11	1.33	.67	0	5.67	1.00	0	.67	.33	1.33	71.00	0	0	66.00	16.33	2.66	16.00	33.90	5.04

Table 8.6a. Distribution of associations in period and phase categories by cluster grouping.

Cluster	Mixed	Unsp Lithic	Unsp Ceramic	Archaic	Form Lithic	Early Ceramic	Late Ceramic	N	Percent of Total
1	2.07	72.11	17.17	0.00	0.24	0.97	7.43	821	45.71
2	3.80	71.86	15.21	0.00	0.76	1.52	6.84	263	14.64
3	1.45	76.81	10.14	0.00	1.45	1.45	8.70	69	3.84
4	0.56	79.89	12.29	0.00	0.00	1.68	5.59	179	9.97
5	5.03	73.18	17.88	0.00	0.00	1.12	2.79	179	9.97
6	1.18	75.29	15.29	0.00	0.00	0.00	8.24	85	4.73
7	6.12	61.22	14.29	0.00	2.04	2.04	14.29	4	2.73
8	6.38	0.00	14.89	19.15	55.32	0.00	4.26	4	2.62
9	5.13	55.13	20.51	0.00	2.56	0.00	16.67	7	4.34
10	8.70	65.22	4.35	0.00	0.00	4.35	17.39	23	1.28
11	0.00	33.33	33.33	0.00	0.00	0.00	33.33	3	.17
Total	2.84	70.21	15.98	0.50	1.89	1.11	7.46	1796	100.00

Table 8.6b. Distributions of recorded surface features in period and phase categories by grouping.

Cluster	Mixed	Unsp Lithic	Unsp Ceramic	Form Lithic	Early Ceramic	Late Ceramic	N of Features	Percent of Total
1	8.10	48.65	13.51	5.40	2.70	21.62	37	26.62
2	5.40	51.35	18.92	5.40	2.20	16.2	37	36.62
3	0.00	33.33	0.00	0.00	33.33	33.33	3	2.50
4	0.00	87.50	0.00	0.00	12.50	0.00	8	5.75
5	60.00	40.00	0.00	0.00	0.00	0.00	15	10.79
6	16.67	33.33	0.00	0.00	0.00	33.33	6	4.31
7	33.33	50.00	0.00	0.00	0.00	16.67	6	4.31
8	0.00	0.00	0.00	66.67	0.00	33.33	3	2.50
9	17.65	23.53	41.18	0.00	0.00	17.65	17	12.23
10	14.29	71.43	0.00	0.00	14.29	0.00	7	5.03
Total	15.11	49.64	13.67	5.03	3.59	15.83	139	100.00

Table 8.7a. FAR and surficial ash stain features in clusters; stains are categorized into those greater and less than 1 meter in maximum dimension.

	FEATURE TYPE						
CLUSTER	FAR	FAR STAIN <1M	FAR STAIN >1M	STAIN <1M	STAIN > 1M		N
1	32.43	16.22	16.22	16.22	16.22		37
2	48.65	18.92	10.82	10.82	10.82		37
3	33.33	33.33		33.33			3
4	37.50		25.00		25.00	12.50	8
5	13.33	26.67	1.33	20.00	20.00		15
6	16.67	16.67		33.33	16.67	16.67	6
7	50.00		16.67	16.67	16.67		6
8	66.66	33.33					3
9	17.65	5.88	11.76	23.53	35.29	5.88	17
10	42.80	14.29	14.29		28.57		7

Table 8.7b. Frequency of excavated features in clusters.

	FEATURE TYPE			
CLUSTER	PIT STRUCTURE	PITS	FAR/ STAIN	STAIN
1	4	2	1	
2		4		
3				
4		1		
5	3	1		1
6				
7				
8				
9	1	3	1	3
10	1			

Table 8.8. Fire-altered rock material type frequencies in summed FAR assemblages for each cluster.

CLUSTER	FAR Material Types				
	CVOL	CCS	QZT	SS	CALICHE
1	99	16	47	94	7505
2	274	25	80	632	3232
3	19	2	7	28	595
4	32	0	10	21	1455
5	56	5	26	62	1210
6	31	5	8	47	756
7	4	2	4	13	426
8	16	14	5	18	497
9	76	4	10	57	878
10	20	1	0	10	232
11	9	0	36	1	8

Table 8.9. Material types and size classes for fire-altered rock and incomplete groundstone in clusters.

Cluster	Material Type	Size Class 0-3cm	3-6cm	6-10cm	|10cm	N	% CFAR	% GS
1	CFAR	---	87.5	11.5	1.0	7505	94.19	5.81
	NCFAR	3.4	80.0	15.1	1.5	265		
	FAGS	13.1	58.6	25.3	3.0	198		
	GS	13.8	47.9	32.2	6.1	376		
2	CFAR	---	83.9	14.4	1.6	3232	73.34	26.66
	NCFAR	0.5	73.1	21.7	4.7	1022		
	FAGS	7.2	62.7	28.1	2.0	153		
	GS	14.3	50.6	30.1	5.0	259		
3	CFAR	---	86.9	12.3	0.8	595	88.15	11.85
	NCFAR	0.0	82.1	17.9	0.0	56		
	FAGS	0.0	58.3	41.7	0.0	24		
	GS	14.0	42.0	36.0	8.0	50		
4	CFAR	---	83.8	14.9	1.3	1455	93.57	6.43
	NCFAR	0.0	0.0	92.4	7.6	66		
	FAGS	5.9	58.8	29.4	5.9	34		
	GS	14.0	46.0	27.0	13.0	46		
5	CFAR	---	84.1	14.3	1.6	1210	72.72	27.28
	NCFAR	1.3	78.1	16.6	4.0	151		
	FAGS	19.8	59.4	18.5	2.3	303		
	GS	16.0	52.2	25.7	6.1	343		
6	CFAR	---	87.4	10.8	1.7	756	87.30	12.70
	NCFAR	2.2	76.1	15.2	6.5	92		
	FAGS	0.0	66.7	27.8	5.6	18		
	GS	16.8	48.5	27.7	6.9	101		
7	CFAR	---	68.3	29.6	2.1	426	90.45	9.55
	NCFAR	0.0	62.5	33.3	4.2	24		
	FAGS	9.5	52.4	23.8	14.3	21		
	GS	10.0	44.0	28.0	18.0	50		
8	CFAR	---	82.9	15.7	1.4	412	83.74	16.26
	NCFAR	8.8	82.5	8.8	0.0	57		
	FAGS	13.0	52.2	34.8	0.0	23		
	GS	0.0	54.5	36.4	9.1	33		
9	CFAR	---	87.5	11.6	0.9	878	80.85	19.15
	NCFAR	2.6	79.5	15.2	2.6	151		
	FAGS	12.3	64.9	17.5	5.3	57		
	GS	19.9	47.7	28.5	4.0	151		
10	CFAR	---	84.1	14.7	1.3	232	81.40	18.60
	NCFAR	0.0	77.4	19.4	3.2	31		
	FAGS	0.0	22.7	68.2	9.1	22		
	GS	9.1	54.5	24.2	12.1	33		
11	CFAR	---	62.5	37.5	0.0	8	3.14	96.86
	NCFAR	49.0	51.0	0.0	0.0	49		
	FAGS	52.0	44.9	3.0	0.0	198		
	GS	0.0	33.3	66.7	0.0	39		

NOTES: *CFAR= carbonate fire-altered rock
NCFAR= noncarbonate fire-altered rock
FAGS = fire-altered groundstone
GS = incomplete groundstone

Table 8.10. Flake and debris use in clusters.

Cluster	Utilized Edges: Flakes/Debris	Utilized Edges: Utilized Flakes/ Debris
1	0.07	1.88
2	0.138	2.48
3	0.283	3.22
4	0.465	1.27
5	0.121	1.71
6	0.141	1.47
7	0.156	1.11
8	0.177	1.60
9	0.057	1.47
10	0.113	1.53
11	0.391	2.25

Cluster 4. High frequencies of utilized flakes but overall low densities of chipped stone, groundstone, and FAR obtain for assemblages in Cluster 4 with most in the Unspecific Lithic category. In comparison to Cluster 3, the proportion of flake tools is higher for the summed assemblages in this cluster but the mean number of utilized edges per flake tool is low. Associated features are variable and include two pits and surficial accumulations of FAR. Excavated features include Unit 50, Feature 4, a pit structure, and Unit 21SW, Feature 3, dense mounded accumulation of FAR with some subsurface ash staining (O'Leary, personal communication).

Cluster 5. Abundant fragmentary groundstone and fire-altered groundstone much of which occurs in very small pieces (Table 8.9) are present in associations in Cluster 5. These items contribute to a mean density that is the highest one for any cluster. In addition, ceramic frequencies are relatively high with most identifiable sherds belonging to jars. Mixed and Unspecific Ceramic categories contribute slightly more than expected numbers of associations to this cluster although the majority are Unspecific Lithic. Cluster 5 features include three adjacent pit structures excavated in Unit 48SW (see Chapter 9) along with a dense concentration of ceramics. Other excavated features include Unit 48NW, Features 2 and 3, both shallow ash stains also associated with ceramics.

Cluster 6. Moderately low density distributions in Cluster 6 contain high frequencies of most flake types and of angular debris. Late stage flakes are abundant as are small cores. Bipolar flakes are moderately abundant in assemblages, as well. Incomplete groundstone and recycled groundstone in the form of noncarbonate FAR, which includes sandstone and volcanic rocks, is also moderately abundant. Unspecific Lithic and Ceramic associations are in the majority. Assemblages in this group are similar to those in Cluster 8 but small cores replace formal tools as high frequency items. Comparing the summed bowl and jar counts for assemblages in this group, relatively high bowl to jar ratios (Table 8.11) are obtained. Features in this cluster were not excavated but include moderately large, up to a meter in diameter, shallow stains with and without associated FAR.

Table 8.11. Ratio of bowl to jar sherds in clusters.

Cluster	Bowl:Jar sherds
1	.38
2	.17
3	.20
4	.08
5	.12
6	.67
7	.31
8	.66
9	.35
10	.75
11	.03

Cluster 7. Cluster 7 is another group of low density distributions which include more Mixed, Early, and Late Ceramic associations than expected given the overall proportions of associations in periods and phases. Formative Lithic associations are also included in this group. The frequency of incomplete groundstone is moderately high and hammerstone frequencies highest for assemblages in Cluster 7, flake and angular debris counts are the lowest. Features include surficial ash stains, accumulations of FAR lacking subsurface staining and a single

excavated oval pit 80 centimeters in length interpreted as a hearth.

Cluster 8. Formative Lithic and Archaic associations make up most of the distributions in Cluster 8 which is characterized by high frequencies of formal tools. Mixed assemblages are also well represented. Similar to Cluster 6, high frequencies of undifferentiated, late stage, and bipolar flakes are also characteristic of this group, suggesting flake production from late stage cores and recycled tools. Relatively high frequencies of bowl sherds also occur--another similarity with Cluster 6. Features in this clusters are FAR accumulations, one associated with a shallow deposit of ash.

Cluster 9. Artifacts rather than FAR are responsible for moderate density associations in Cluster 9. Highest mean counts of angular debris, bipolar flakes, biface thinning flakes, undifferentiated flakes, and late stage flakes were obtained for this group. Flake utilization is also high with moderate amounts of core material represented, as well as fragmentary and fire-altered groundstone. About three times as many jar sherds as bowl sherds are present in ceramic assemblages in this group suggesting processing and storage dominated use of containers. Abundant FAR reinforces this interpretation. Discard of moderate numbers of cores and formal tools are also indicated.

This cluster contains highest proportions of Unspecific Ceramic associations as well as including more Mixed, Formative Lithic, and Late Ceramic associations than expected given the overall proportions of associations in period and phase categories. About 4 percent of all spatial associations are contained in Cluster 9, which includes over 12 percent of the recorded features (Table 8.6), a pattern pointing to feature-focused use and reuse of places as a determinant of high artifact frequencies. Features are variable and include accumulations of FAR some associated with surficial ash stains, pits, and a possible pit structure. Excavated features include a shallow basin shaped pit interpreted as a hearth (Unit 45SE, Feature 8), a bell-shaped pit measuring 165 x 175 x 47 centimeters (Unit 45, Feature 12), and a shallow, irregular shaped stain (Unit 45, Feature 8), interpreted as a possible pit structure.

Cluster 10. High undifferentiated flake, late stage flake, and angular debris counts characterized assemblages in Cluster 10 and biface thinning flakes occur in moderate numbers. The mean sherd count is the highest of any cluster group with jars dominating in assemblages. More Mixed, Early, and Late Ceramic associations than expected are present in this group although Unspecific Lithic associations are in the majority. The groundstone assemblage in this cluster is distinguished by the frequent occurrence of complete manos and moderate amounts of fragmentary and fire-altered groundstone. About 30 percent of the associations in this group contain features which include pits and surficial ash stains and one excavated pit structure (Unit 75, Feature 5).

Cluster 11. Cluster 11 includes only three spatial associations, an Unspecific Lithic, Mixed, and Late Ceramic association, distinguished by extremely high frequencies of fragmentary and fire-altered groundstone. Two of these associations also contain moderately high frequency of jar sherds. The fact that no features were recorded at clusters in this group indicates that moderately high densities of fragmentary and fire-altered groundstone simply litter the surface of each distribution and occur with high densities of utilized and unutilized flakes. The noncarbonate FAR in this cluster consists of pieces of quartzite which occur in equal proportions in the 0-3 centimeter and 3-6 centimeter size range. Over half of the fire-altered groundstone also occurs in the 0-3 centimeter size range indicating that groundstone in this cluster is either highly weathered or was subjected to enough heat to become highly fragmented.

Cluster Interpretations

Two major differences in spatial association content are indicated by the cluster analysis of chipped stone and groundstone assemblages. Differences among clusters in terms of chipped stone artifact classes include those with abundant flakes (of all types) and angular debris versus those with moderate to low frequencies of flakes and debris but with relatively high frequencies of tools or cores--including small and large core classes, formal tools, and utilized flakes. In one case, Cluster 9, utilized and unutilized flakes are both abundant. Another major contrast among clusters is in the amounts of noncarbonate FAR, presumably recycled groundstone, and fire-altered groundstone in the summed assemblages of each cluster (see Table 8.9).

Reconstructing the "functions" of spatial associations of artifacts based on the chipped stone artifact contents is beset with problems. A number of causes for abundant flake debris can be identified including the recycling or reworking of tools and cores, prolonged or intensive processing using flake tools, or frequent manufacture of tools producing abundant flake debris. Either intensity or duration of activities, rather than just tool and core recycling, could account for the major contrast in chipped stone tool content among assemblages.

These contexts for flake production could be attributed to several functional components of a settlement system. Prolonged or intensive processing might occur, for example, at residences and at special use field locations, both of which are also potential settings for tool recycling. Models of mobile systems presented in Chapter 3 cite instances of reuse of old residential sites for special purpose occupations and vice versa, while in more sedentary systems seasonal residences and other field locations tend to be reoccupied again and again for multiple purposes.

The repetitive short distance transport of cores, hammerstones, and formal tools, all likely targets for reuse in a desert basin setting where lithic raw material is deficient, also ensures that spatially associated items may have never been used together during single episodes of activity or single occupations. In addition, although items in assemblages produced through chipped stone recycling can be assumed to be smaller and have less cortical covering, it is really not possible to discern chipped stone recycling, that is scavenging or the reworking of discarded tools versus simply the maintenance of items, directly from the basic attributes of tool or debris morphology. Reuse of a discarded flake, for example, is probably not distinguishable from the intensive use of a flake tool. Tool remodeling may be more successfully analyzed on a case-by-case basis with facially flaked tools which exhibit evidence reshaping or reworking along formerly broken edges, but such tools are virtually absent from the chipped stone assemblage documented here.

The angular and burned appearance of fragmented groundstone, on the other hand, is a more reliable indicator of recycling. It has obviously been reused for another purpose. The use of groundstone in hearths has been widely recognized in the southern basins of New Mexico and discussed in terms of a functional distinction between caliche hearths and rock hearths (Carmichael 1973:200-201; O'Laughlin 1979; Whalen 1980).

Features containing FAR or which lack associated FAR should be useful indicators of the differential use of places. Surficial stains lacking associated FAR include small unlined pits interpreted as hearths and larger shallow saucer-shaped pits interpreted as structures. FAR occurs in surficial mounded accumulations sometimes superimposed upon or adjacent to subsurface pits and in dispersed surficial scatters often associated with ashy soil. A functional distinction exists between the use of rocks as heat retention elements in hearths, roasting pits, and possibly several forms of containers (including pottery vessels, gourds, and skins) and the use of hearth features which simply served as sources of light and heat for camp occupants--one that could be modeled as contrasting some sort of processing with general domestic activities. Small pit structures may have been used primarily as storage places for perishable goods and sources of shade (Yellen 1977; Fowler and Fowler 1971).

Segregating clustered lithic assemblages on the basis of the amount of noncarbonate rock in FAR assemblages and the prevalence of features lacking FAR provides some controls for effects of recycling and general functional differences in how places were used. Imposing these controls, there are five groups of clustered assemblages whose compositional history in terms of function and reuse can be interpreted (Table 8.12). Importantly, when paired with measures of artifact variety, these groups can be argued to differ in perhaps general functional ways and their surface assemblages interpreted as resulting from differential reuse and degree of anticipated use of places. In addition, some clustered lithic assemblages associated with abundant ceramics can be interpreted as resulting

Table 8.12.. Assemblage groups as defined by amount of recycled groundstone, associated features and measures of lithic assemblage variety and distribution density.

	N Clusters	Percent Fire-altered Groundstone	Percent Features w/o FAR	Variety/Density Relationships	
Group I				r	p
Cluster 6	85	12.70	50.00	0.326	0.002
Cluster 9	78	19.15	58.82	0.440	0.0001
Group II					
Cluster 1	821	5.81	33.33	0.449	0.198
Cluster 3	69	11.85	33.33	0.084	0.489
Cluster 4	179	6.43	25.00	0.070	0.350
Cluster 7	49	9.55	33.34	0.173	0.233
Group III					
Cluster 5	179	27.28	40.00	-0.100	0.182
Group IV					
Cluster 2	263	26.66	21.64	-0.030	0.625
Cluster 8	47	16.26	0.0	-0.208	0.160
Cluster 10	23	18.60	28.57	-0.099	0.650
Group V					
Cluster 11	3	96.86	---	-0.068	0.956

from systematic reuse of places in desert basins by relatively sedentary adaptations.

Table 8.12 lists clusters, the proportion of noncarbonate FAR inferred to be recycled groundstone in the summed assemblages of each cluster, and the percentage of features which lack associated FAR at locations represented by each cluster. A final column in this table lists the Pearson's product moment correlation coefficient calculated between artifact class variety (using the 14 lithic classes upon which the cluster analysis was based) and the density of all material, lithic, ceramic and FAR, in spatial associations belonging to each cluster. Five groups of clusters can be distinguished.

Clusters 6 and 9, distinguished by high artifact frequency and variety, are listed in the table as Group I. About half of the features in assemblages in these clusters lack FAR and the proportion of recycled groundstone in the summed assemblage for each cluster is high. The relationship between artifact variety and the density of items at locations containing clustered assemblages in this group is weakly positive but statistically significant. The introduction of content into places represented by this group can thus be modeled as "additive"; that is, raw materials and tools are continually introduced into places — a process which contributes to increased density of debris and, at the same time, increased variety.

This is the kind of relationship that has been modeled for assemblages produced by the residential occupations of foragers (Camilli 1983:53-55; Binford 1988:5-10; Yellen 1977). In foraging contexts, incremental buildup of materials at base camps produces higher densities of debris and a greater variety of items in assemblages which result from longer durations of occupation. Daily foraging trips encounter food resources and nonfood items which are brought back to camp with the result that the duration of occupation as measured by number of consumer days spent in one spot "drives" a density/variety relationship.

It seems clear, given the discussion in Chapter 3 of patterns of site reuse by ethnographically known groups, that the potential for differences in the occupational histories of locations may also result in the generation of assemblages at some locations which will be much more complex than at others. More heterogeneous assemblages resulting from multiple occupations could be expected to have larger and more diverse assemblages than those of single occupations. A direct relationship between assemblage size and diversity may, thus, also be indicative of reuse of locations for functionally different purposes such that some are larger and more diverse.

Re-examining Table 8.12 then, assemblages in the Group I clusters which have been characterized as "additive" may have resulted from the incremental buildup of debris discarded during the course of base camp occupations and from the reuse of localities by foragers and special task groups who repositioned base camps and other non-residential activities near or partially on top of the sites of abandoned occupations. Over a long time span, these behavioral processes are augmented by natural post-depositional processes which serve to deflate any sediment separating material deposited during separate activity episodes into a single horizontal layer. Thus, the additive character of assemblages in this group as evidenced by the positive relationship between assemblage size and variety may be due in large part to their composite history. A land-use pattern which creates functional composites and the accumulation of differential amounts of material at camps occupied for variable lengths of time could, thus, each account for Group 1 assemblages.

A second group of assemblages those in Clusters 1, 3, 4, and 7 may have compositional histories that can also be described as additive. Among assemblages in these Group II clusters, there is a positive relationship between lithic artifact class variety and density, although the correlation coefficients obtained are not statistically significant. Locations containing Group II assemblages may also, however, result from the long-term accumulation of debris from activity episode that are widely spaced in time as well as and from activities in a residential occupation. In contrast to Group I, the proportion of recycled groundstone is low and fewer features in this group lack FAR. The comparatively low amount of groundstone suggests less recycling and therefore less reuse of places, while the greater abundance of FAR features indicates some functional differences in activities performed between Group I and II assemblages. A number of excavated pit structures associated with some Cluster 1 assemblages in Group II points to the residential character and therefore to the incremental buildup of remains.

More FAR features in this group indicate functions involving use of hearth rock in contrast to Group I assemblages. This difference may be explained by seasonal differences in activities rather than difference in settlement type between Group I and Group II assemblages if most are residential in nature.

The structure of all residential assemblages in a system should be determined by incremental buildup of debris, resulting in greater assemblage variety and size with longer occupations. Actual assemblage composition between individual locations may, however, vary with seasonal differences in the activities performed at residential bases. Seasonal differences in the function of features at residences may therefore account for some of the difference in the abundance of FAR in features between Group I and II. More abundant processing features incorporating FAR may also indicate that assemblages in Group II are functional composites generated by nonresidential field processing tasks and residential occupations.

Groups III and IV contain assemblages which could be modeled as essentially "subtractive". That is, as density increases the variety of lithic artifact classes decreases in assemblages. Groups III and IV contain clusters with high proportions of recycled groundstone in summed assemblages (Tables 8.8 and 8.12). The difference between Group III which includes only Cluster 5 and Group IV including Clusters 2, 8, and 10 is that the former contains a high proportion of features lacking FAR. Looking at Table 8.7, a majority of excavated features associated with Cluster 5 assemblages are pit structures.

Very high proportions of groundstone in the FAR assemblages of Cluster 5 and Cluster 2 are evidence for more systematic rather than casual reuse of places, although as pointed out above the abundance of very small pieces of noncarbonate rock in the summed assemblage of Cluster 5 may be due to erosional rather than behavioral processes. Functional redundancy and site reuse are characteristics of a number of kinds of locations in sedentary as well as mobile systems. As described in Chapter 3, the increasing permanence of the main residential base has been used to explain functional repetition in the use of particular places in more sedentary systems (Binford 1982:21). Tools used in seasonal agricultural or collecting activities may not contribute to assemblage variety at activity specific locales since "site specific activities (either agriculture or collecting) are taking place off the site and the tools associated with those activities were 'curated' or eventually returned to the home site" (Powell 1980:137). In addition to the removal of items from reused field residences on a regular basis, discarded tools are potentially subject to a high degree of recycling during reoccupation of seasonally used residences and other activity areas. Thus, prolonged reuse of these places may result in dense distributions of material lacking much variety in tools and debris.

The mean ceramic counts for assemblages in Clusters 5, 8, and 10 are evidence for repetitive use of areas by seasonal sedentary systems in the El Paso region. Lack of ceramics and the presence of pit features in Cluster 2 may point to purposeful reuse of actual processing features rather than systematic reuse of seasonal residences.

Cluster 11 makes up the last group of assemblages. It is distinguished by FAR assemblages dominated by small pieces of quartzite. While use of fire and therefore of features is indicated by the fragmentary and fire-altered condition of this rock, no features were documented at the locations containing these assemblages. There are several possibilities that could explain a lack of features. Features simply may have gone unobserved in the field during discovery phases of the survey,or features may have been deflated and are no longer recognizable. In addition, although at least one episode of artifact reuse is indicated--groundstone artifacts were used as hearth elements at least once--the abundance of small fragments in the FAR assemblage may also be due to reduction of quartzitic groundstone during its initial use in a feature or by natural erosional processes.

SUMMARY

Groups I, III, and IV are each characterized by high proportions of recycled groundstone in assemblages; Group I contrasts with Groups III and IV in that there is evidence for an "additive" history of accumulation, while the other two groups show no such tendency. This suggests that the degree of recycling that groundstone assemblages may undergo, and, therefore, the amount of location reuse are not necessarily equatable with a growth in overall assemblage variety or the presence of residential or non-residential features. Some places like those represented by Group I appear to have been the targets for reuse for a number of functions, this land use pattern contributing to assemblage variety. Others, like those in Group III and IV, may have undergone more systematic reuse during which assemblages were targeted for recycling; this latter land use pattern resulting in decreases in variety. Low proportions of recycled groundstone are uniformly patterned with relatively abundant FAR features and assemblages which appear to be "additive" in Group II. Lesser amounts of recycled groundstone in this group are linked with additive processes of assemblage formation.

Another factor which might affect the additive or subtractive character of assemblages is the surface availability of recyclable materials, as conditioned by natural post-depositional processes. It may be that Group III and IV assemblages have offered more accessible and recyclable resources "left behind" in the past due to prolonged periods of exposure, while reuseable lithic materials in Group I assemblages were rapidly covered by sediment and have remained unexposed for longer periods of time. Thinking about present erosional patterns and, thus, archaeological visibility as well, the possibility cannot be overlooked that variable exposure rates for groundstone and smaller chipped stone items may account for patterns of low frequencies of chipped stone in assemblages. The question of the effects of post-depositional processes will be addressed in the final section of Chapter 8 through an examination of the topographic distributions of artifact associations.

A premise of this section has been that "site" relocation by prehistoric inhabitants of the El Paso region has resulted over the long-term in the reuse of most locations and in the combination of debris from separate occupations into aggregates of spatially associated artifacts. Accepting the composite character of the archaeological record, features alone do not provide data suitable for inquiring into the compositional histories of assemblages with which they are associated. An important result of this analysis is that functional and historical interpretations of assemblage content crosscut the presence features and structures in spatial associations. Functional interpretations of places containing structures as simply residences do not consider the potential for the variable histories of use of these places, thus ensuring that determinations of "site" function cannot be realistically accomplished. In addition, determining the position of spatial aggregates of artifact and features on a cultural-historical continuum is not possible because "laws" of spatial association do not apply.

Examining the archaeological record of the West Mesa, the cumulative effects of the history of the use of places on this landscape can be attributed to the variable ways systems have positioned and repositioned themselves on the landscape. The findings presented here suggest that analyses of landscape use must begin to experiment with units of observation which are not based on the criterion of spatial association. Such analyses could be implemented with a grid network at varying spatial scales, for example, using recycled artifacts as controls for comparing portions of landscape which were reused more intensively than others. This will be attempted in Chapter 9 with an analysis of feature assemblages. The final section of this chapter compares the topography of an intensively surveyed unit with the interpreted histories of spatial associations.

Differential Visibility of Archaeological Surface Materials

The interpretations of the lithic artifact content of archaeological surfaces presented in the preceding analyses have raised at least two questions centering around differential visibility of surface materials. The first of these concerns how natural post-depositional

Unit 45

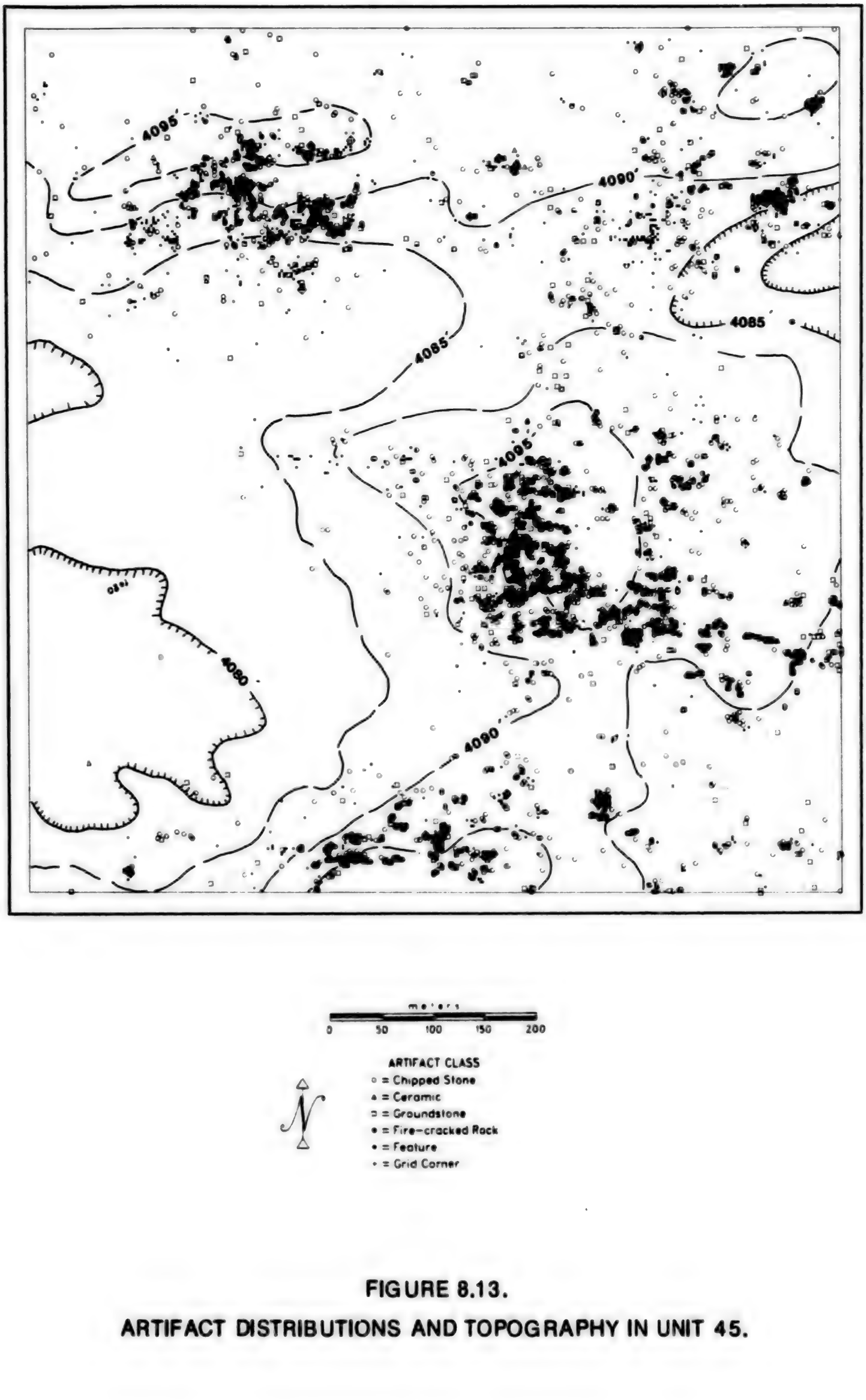


FIGURE 8.13.

ARTIFACT DISTRIBUTIONS AND TOPOGRAPHY IN UNIT 45.

processes have affected their discovery, and the second asks if differential visibility in the prehistoric past conditioned the availability of lithic materials for reuse or recycling. Both of these possibilities require that the surface "archaeological" visibility of lithic materials must be taken into account when drawing conclusions about past use of the West Mesa landscape. This section describes the differential potential for discovery, both prehistoric and contemporary, of surface artifacts with respect to two important natural variables affecting visibility, elevation, and exposure.

The results of a recent analysis of the distribution of chipped stone and groundstone in Unit 45 by Backer (1985) demonstrate a correspondence between surface distributions and topographic features. Unit 45 is situated in Nials' environmental stratum 3C, the Yucca Dunes Zone and High-relief subzone, and covers the northeastern quarter of Section 9, T. 29 S., R, 2 E. Elevations range from 4,096 to 4,080 feet, a difference of 16 feet or 4.88 meters over a minimum distance of about 200 meters in this unit (Figure 8.13). In most of the southwestern United States, this kind of topography would be considered essentially flat but in comparison to other survey units on the West Mesa surface, Unit 45 exhibits relatively high relief and therefore provides a format for examining the differential distribution of artifacts with respect to topography.

Elevational changes are extremely subtle in Unit 45 (Figure 8.14). Nonetheless, there are correspondences between the environmental parameters inspected here and artifact occurrence. The topographic differences within this unit are so slight, in fact, that it cannot be realistically imagined that individual people using this area prehistorically (or even today) would have noted these differences in terms of "preferences for places with a view" in occupying specific areas there. In many places, they are so small as to be undetectable when casually walking across the surface. The correspondence between artifact occurrence and topography should thus be considered as at least partial evidence that the differential visibility of the archaeological surface in desert basins can play a role in determining what is discovered on that surface. Discovery of lithic materials can be seen to have implications both for the prehistoric use of lithic materials there, and for the discovery of such materials by archaeologists as well. The factor of surface

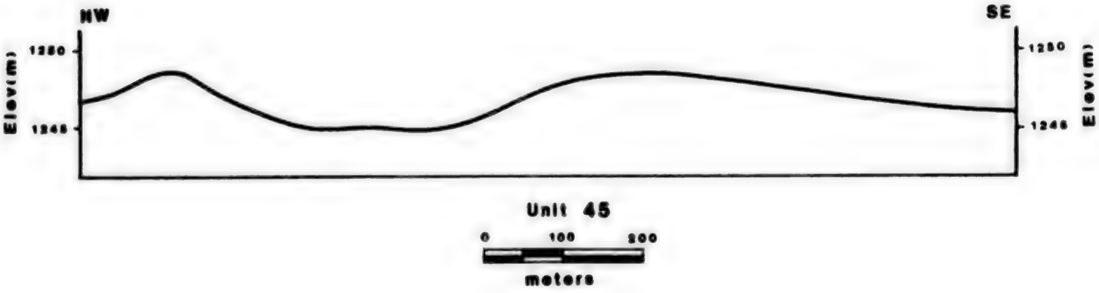


FIGURE 8.14.
ELEVATION PROFILE OF UNIT 45.

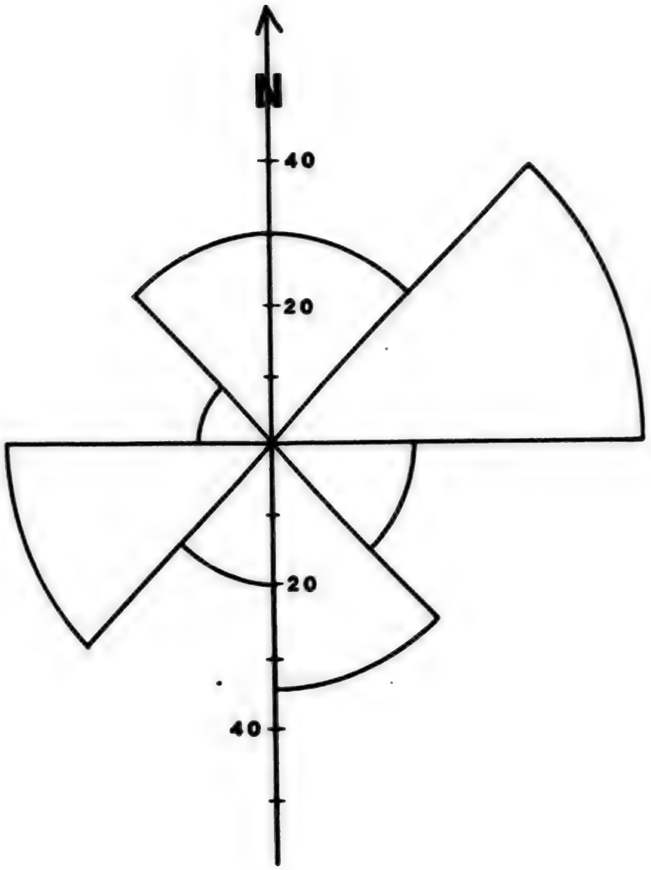


FIGURE 8.15.

EXPOSURE PATTERN FOR 300 RANDOM POINTS IN UNIT 45.

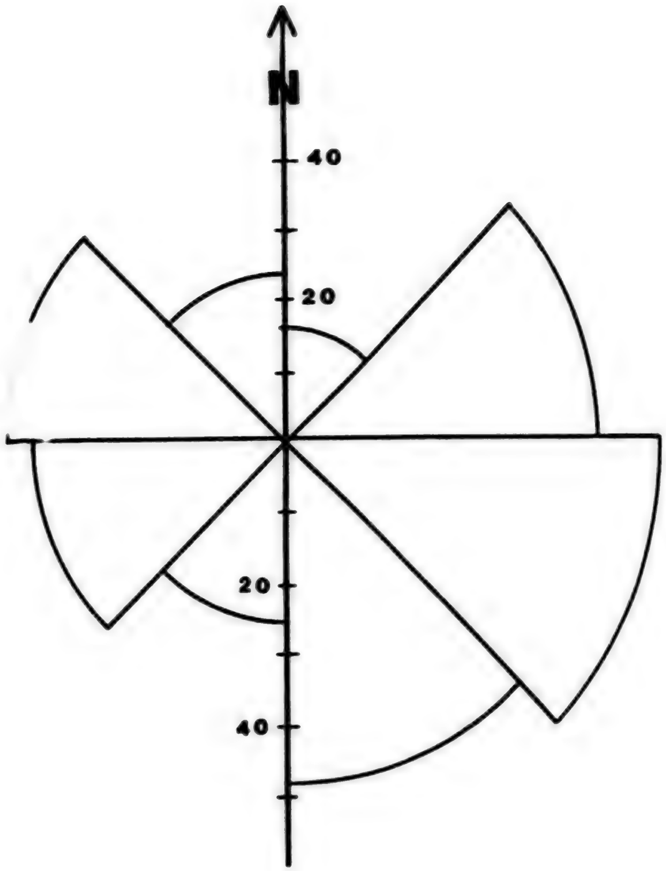


FIGURE 8.16.

EXPOSURE PATTERN FOR ARTIFACT ASSOCIATIONS IN UNIT 45

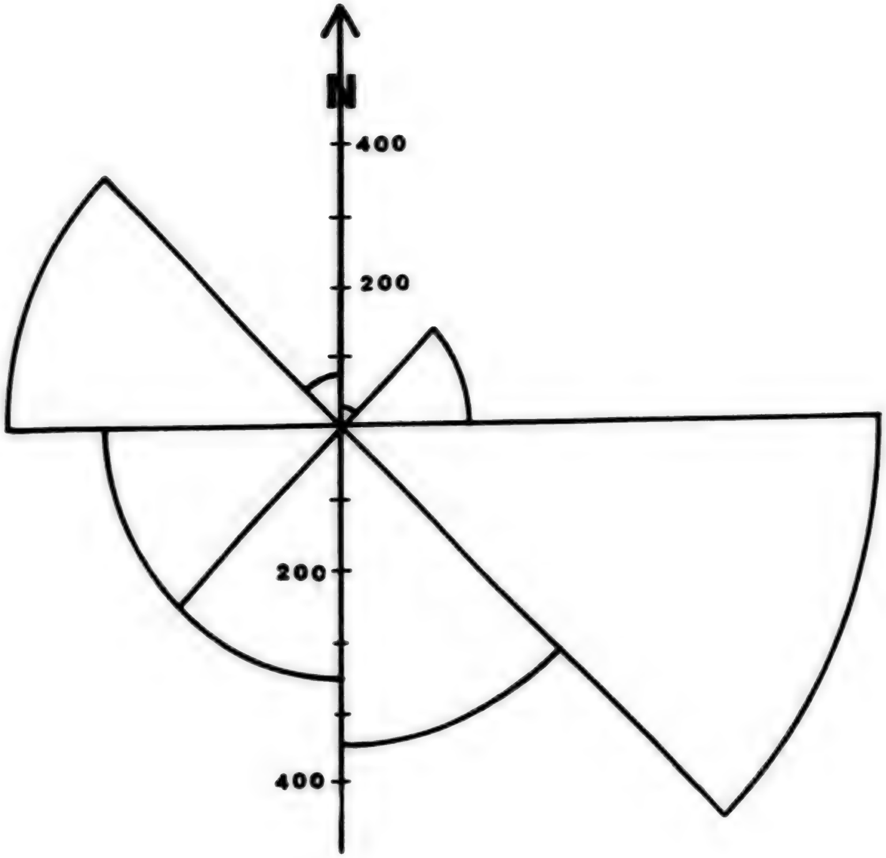


FIGURE 8.17.

EXPOSURE PATTERN FOR CHIPPED STONE IN UNIT 45.

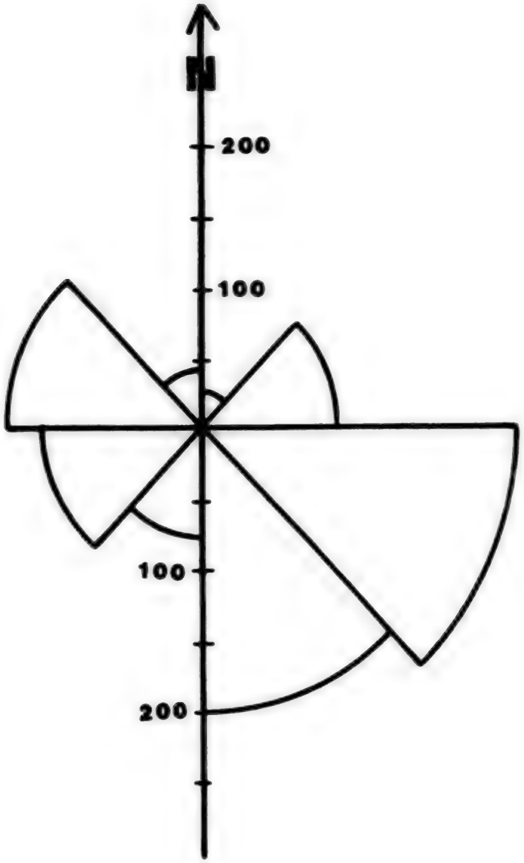


FIGURE 8.18.

EXPOSURE PATTERN FOR GROUNDSTONE IN UNIT 45.

visibility can thus be seen as a variable which links the past availability of lithic materials for recycling or reuse and the contemporary discovery of archaeological materials by archaeologists, leading to interesting and important "feedback" effects between the two.

The topography in Unit 45 includes a north-south trending ridge system punctuated by three low hills. It is bordered on the west by the eastern portion of a large depression or sink and on thenortheast by a smaller one. The northwestern edge of a major depression borders the ridge on the southeast. Southern-, southeast-, southwest- and northwest- facing slopes of the ridge contain clustered artifacts while northeast facing slopes of the central hill on the ridge do not (Figure 8.13). The fact that southern- and western-facing slopes appear to exhibit heavier concentrations of material than do the northeastern-facing slopes of the ridge may be attributed primarily to exposure and to a prevailing southwesterly wind which deposits sand cover on the lee side of the ridge.

Exposure patterns are illustrated in Figures 8.15 and 8.16. Figure 8.15 illustrates the exposure of the locations of 300 random points imposed on the Unit 45 landscape and graphed by Backer (1986:Figure 11). By clustering the x and y spatial coordinates of artifact and features, 345 spatial associations of items were obtained for Unit 45. Using the center points of each spatial association, the frequency of these artifact concentrations was also graphed for eight cardinal directions (Figure 8.16). Comparison of the rose diagram illustrating the exposure of random points and the actual distributions of artifacts, shows that associations of artifacts occur more frequently than expected on slopes exposed to the northwest, south, southwest, and southeast. Comparisons of the raw numbers of chipped stone and groundstone artifacts in clusters with exposure (Figures 8.17 and 8.18) results in similar findings. Thus, on this 800 x 800 meter surface, artifacts on the lee sides of ridges and hills may be covered by a mantle of sand which precludes their visibility. Pierce and Durand (1986:Figure 11.3 and 11.12) illustrate a similar pattern of low artifact density on a northeast-facing scarp in Section 6, T. 29 S., R. 2 E. of the Santa Teresa study area.

Elevation is another environmental correlate of artifact frequency. Figure 8.19 illustrates the frequency of chipped stone and groundstone artifacts and FAR in spatial associations grouped by 1 meter intervals. Below about 4,086 feet on the lower slopes of ridges, the ratio between chipped stone and groundstone is constant. As

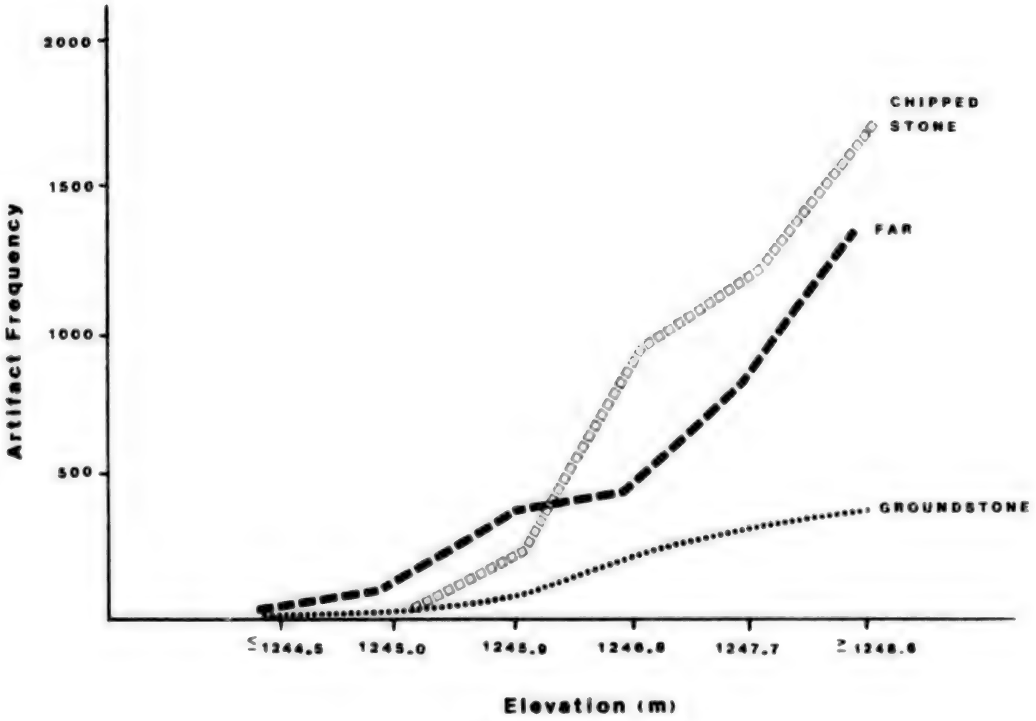


FIGURE 8.19.

FREQUENCY OF CHIPPED STONE, FAR, AND GROUNDSTONE BY 1M INTERVALS OVER ELEVATION IN UNIT 45.

one moves upslope from this elevation, this ratio become increasingly large. The ratio between FAR, which is larger than chipped stone, and groundstone begins to increase radically at slightly higher elevations on the upper slopes of ridges.

Table 8.13 lists lithic artifacts by size classes, their frequencies, and the relationships between elevation and the frequency of different sized lithic artifacts in 221 spatial associations. The frequency of all size classes is positively correlated in a weak but significant fashion with elevation. The densities of smaller-sized items are also significantly correlated with elevations, higher elevations containing higher densities of the smaller items, but the densities of larger items do not vary in a significant fashion wwith elevation. Because the rate of initial discovery of smallest sized artifacts has been shown to be the lowest and affected to a greater degree than larger artifacts by weather and light conditions as well as the color of the artifacts themselves (see Chapter 5), artifacts measuring less than 3 centimeters were not included in this table. Their frequencies are significantly correlated with elevation but the densities of these items are not.

An interplay between behavioral and geomorphic processes is suggested by the relationships between a chipped-to-ground stone ratio and elevation. Two aspects of chipped stone and groundstone discard stemming from production techniques and modes of use of tools that are produced through percussion versus grinding and pecking must be considered. Simply put, these are that items of chipped stone are discarded at a higher rate than are groundstone artifacts and that chipped stone artifacts are smaller than those of groundstone. Given the difference in discard rate, one would expect that the ratio of chipped stone to groundstone would be higher in areas where both types of artifacts were used and that with the accumulation of more debris over the long-term this ratio would increase through the period of prehistoric occupation. However, the larger items of groundstone occur in equal proportions to chipped stone on the lower slopes of ridges. (In the case of FAR, it is more frequent than is chipped stone in all areas.)

This pattern suggests that deeper sand cover around depression ridges is responsible for obscuring the visibility of chipped stone there and that the ratio of chipped-to-ground stone on the well-scoured interdunal surfaces on ridgetops represents actual chipped stone:groundstone frequency relationships in these areas. If this interpretation holds then there is a much higher degree of archaeological visibility on the interdunal surfaces of upper southern and northwestern-facing slopes and on ridgetops than on lower slopes.

In addition, if the visibility of groundstone is constant to a greater degree than that of chipped stone--that is, if most groundstone in all areas is equally visible--then behavioral reasons must be cited to explain the greater frequencies of groundstone on ridgetops compared to lesser amounts of groundstone on lower slopes. It is important to remember that the visibility of surface artifacts is not just a unique factor affecting the process of archaeological discovery but a phenomenon affecting the visibility and thus the availability for reuse of artifacts in the past as well.

If chipped stone is more available for recycling on ridgetops, these areas would have served as targets for the reuse or recycling of suitable discarded lithic material by occupations which may also have required groundstone and hearth rock. In this case, targeting higher elevations for chipped stone recycling results in a kind of "feedback" process. The need to use discarded chipped stone artifacts as lithic raw materials for the manufacture of new tools and the reuse of discarded artifacts themselves is first focused on the obvious known sources of visible discarded artifacts, the ridgetops, which served as known prehistoric sources of lithic materials. The requirements for chipped stone raw materials accompanied by the need for hearth rock could result not only in the reuse of chipped stone cores and tools but also in the recycling of appropriate groundstone materials as chipped stone cores and other groundstone items as hearth rock. This process results in the accumulation of even higher frequencies of all artifact classes in areas where artifacts have been exposed, and therefore, available for reuse since their original discard.

Table 8.13. Artifact size and its relationships to artifact frequency and density with increased elevation.

Artifact Size Class	Sum	Mean No. per Association	Correlations with Elevation			
			Frequency		Density	
			r	p(r)	r	p(r)
Chipped Stone and Groundstone Debris						
Flake Fragments						
3-6cm	391	1.77	0.268	0.0001	0.174	0.009
6-10cm	176	0.796	0.330	0.0001	0.147	0.028
10+cm	22	0.100	0.154	0.0192	0.033	0.619
Platform-bearing Flakes						
3-4cm	588	2.661	0.309	0.0001	0.194	0.003
4-5cm	265	1.199	0.252	0.0002	0.123	0.067
5-6cm	98	0.443	0.227	0.0007	0.149	0.025
6-7cm	32	0.145	0.139	0.0389	0.083	0.214

Chipped Stone: Groundstone Ratio Correlation with Elevation $\underline{r} = 0.1157$ $p(\underline{r}) = 0.086$

How does this interpretation of the differential distribution of chipped stone and groundstone differ from an interpretation that sees selection of high elevations by prehistoric inhabitants of the region as the prime determinant for high densities of artifact at these places? Basically,in the model of landscape use presented here the number of artifacts in an area cannot be interpreted in any simple way as the result of duration of occupation, the number of persons inhabiting an area, or the intensity of tool manufacture at a location. Different strategies of raw material use, including the degree to which raw materials found at a place are reused, as opposed to carried there to be used, introduce interplay between the episodic use of places and previously discarded archeological materials at these places.

Groups which are geared-up with curated tools might leave very little tool debris and few tools at field locations and base camps regardless of the number of activities undertaken. On the other hand, reworking of chipped stone material and production technique as much as anything else can determine the amount of debris produced. Given a constant amount of lithic raw material, for example, an exponential relationship could be expected between the number of production events and number of pieces of debris in an area. Further, using different production techniques a single production event will produce variable amounts of debris. Bipolar smashing of core material, for example, will produce more debris than controlled percussion flaking. There is no justification for determining that the simple amount of debris found at any place is the result of greater intensities of episodic use of that place in the past, unless lithic raw material procurement options and reduction strategies are taken into account.

Comparing technological components of a system involving the use of carried, prepared items versus encountered, "scavenged" sources of lithic raw material used in places where raw materials are not immediately available, the relationship between manufacturing byproducts and manufacturing or maintenance events could be expected to be diagnostic. Reduction of curated, carried raw materials in the form of prepared cores and tools used as "blanks" for flakes or other tools could be modeled as economical since these materials were previously prepared at other places. Each manufacturing event would result in a minimum of flakes and byproducts that would be discarded. On the other hand, if lithic materials found at a place, and not transported by the persons doing the immediate reduction, were used the manufacturing events could be expected to be less efficient; more fragments could be expected to result from each manufacturing (reuse) blow. There would thus be a differential debris-per-blow effect on the frequency of resultant lithic material in terms of gross frequency of lithic pieces found in each of these strategies. Reuse or recycling, contrasted with the use of carried materials for raw materials, could result in greater numbers of lithic "pieces" per manufacturing event.

Although no definite numbers of items per event will be postulated here, the generalization will be made that areas where reuse or recycling of materials constitutes the major mode of lithic manufacture, the greater the raw numbers of items will be found there. Number of items found in an assemblage is, therefore, far more likely an indication of reuse or recycling than simple intensity of use. For this reason, exposed surfaces with greater numbers of lithic artifacts are interpreted as being areas subject to a high degree of reuse. Rather than being the result of intermittent or seasonal occupations by groups which preferentially sought out ridgetops for the "view" (Pierce and Durand 1986), then, high densities of archaeological materials in these locations may have resulted over the long-term from many, in fact, hundreds of separate activities including recycling events which served to reinforce a pattern of more frequent material discard and reuse at higher elevations.

Patterns noted for the locations of "camps" in the southern basins of New Mexico can be evaluated in light of the possibility that the slopes and hilltops around playas constitute surfaces that are exposed to a greater degree than other places in central desert basins. Most surveys of interior desert basin settings have noted site locations near playas. Beckes and Dibble (1977:77) observed open occupations located "adjacent to a complex of small playas in the central basin" on the McGregor Range. A significant tendency for camp and activity areas (sites less than 1 hectare or lacking one of the three major artifact classes) in the Western Hueco Bolson (Piggot 1978:227) to be located within 300 meters of playa rims may be the result of behavioral patterns similar to those interpreted for the West Mesa if camps are located on exposed slopes and ridgetops ringing playas. In the Eastern Hueco Bolson camps, of all phases including those of undetermined phase were found to be significantly associated with areas within 300 meters of playa rims; a significant association between Mesilla Phase sites and playas was found with 48 percent of Mesilla sites occurring within 450 meters of playa rims; and, a significant number of El Paso Phase sites were found to occur with 1,200 meters of playas rims (Piggot 1978:227). Carmichael (1983:130) also suggests that shift in site location with more sites oriented around playas may be indicated for the El Paso Phase in Tularosa Basin.

If the above documented locations of archaeological sites in desert basins can be attributed to differential archaeological visibility in the past as well as in the present, then sites such as these may not be reliably attributable to specific functions or time periods. This is so then reconstructing settlement patterns with associations of artifacts and features which may have never been used together in the past cannot be reliably accomplished. However, rather than presenting a problem of "multicomponency" for the interpretation of the archaeological record, the reuse of places and the recycling of discarded materials at those places should be extended as a basic behavioral process to most places used in the past. With this perspective, reconstructing settlement patterns within a cultural-historical framework can be abandoned as a goal of archaeological research, the goal becoming one of diagnosing technological and settlement strategies that have been mapped onto landscapes without reference to time or to single events and activities.

CHAPTER 9

SURVEYED AND EXCAVATED FEATURES

Numerous surveyed features present in continuous low-density artifact distributions on the West Mesa occur as mounded accumulations and disarticulated scatters of fire-altered rock (FAR) and as ash-stained surfaces. These latter manifestations are the surface indications of pits and pit structures of varying dimensions which have been excavated into the compact surface of a paleosol forming floor of the Mesilla Bolson. The degree of preservation of such features is variable, their form ranging from shallow lenses of ash less than a centimeter thick which represent the bottoms of deflated pits to well-preserved shallow pit structures the fill of which contains burned roofing materials.

One hundred and fifty-five features were recorded by the Phase II intensive survey in five 800 x 800 meter and six 400 x 400 meter mesa top survey units. This is a mesa top feature density of 37.25 features per square kilometer or about 95 features per square mile. This figure translates into roughly 2,800 surface-discoverable features in the West Mesa portion of the Navajo-Hopi Land Exchange Project (NHLEP) area. Surface indications of more than half, 88, of the 155 features located, include ash-stained soil indicative of buried pits and pit structures. Thus, there are potentially 1,500 or more preserved features and feature remnants in the project area.

Features composed of FAR were readily visible (and were marked with pinflags) while surveying in 5 meter transect intervals during the discovery phase of the survey, but pits and pit structures lacking associated FAR were often not recognized during survey. During the analysis phase of the intensive survey, discovered and flagged features were numbered. Additional features were frequently discovered during the in-field analysis when the thin layer of recent windblown sand obscuring the traces of ash staining was disturbed by analysts walking among pinflagged artifacts and kneeling and sitting in the sand while coding artifacts. Without this inadvertent, but intensive, disturbance of the surface sediment many features would have gone undiscovered.

The high incidence of discovered features indicates that buried features are literally ubiquitous on the West Mesa landscape and that they are very common in areas of low surface artifact density. It is very likely that most ephemeral surface indications of buried features in low-artifact density desert basins are not detected during conventional survey since surveyors do not regularly retrace their paths. The problem of discovering features lacking high densities of associated artifacts, or in fact any associated artifacts, in the coppice dune topography of desert basins could be solved with a program of controlled subsurface testing which is systematically implemented over large continuous areas without regard to artifact concentrations. Such intensive testing has been undertaken in smaller "site" areas where artifact densities are used as clues to the presence of buried features and structures (Hard, personal communication concerning the Conejo site [SB46] excavations on Ft. Bliss, Texas; Whalen 1980). This search strategy ensures, however, that areas of high artifact density will be those where features are more likely discovered.

In addition, unburned features such as pit structures and emptied storage pits lacking ash-stained fill will never be discovered without a systematic subsurface testing program implemented solely for the purpose of locating such features. No unburned features were discovered or excavated by this project, although these are known to be present within the study area. Several such features, discovered through examination of test trench profiles, have been documented for the Dona Ana County Airport site (Batcho et al. 1986) and have also been recently excavated by the Office of Contract Archeaology (OCA) in Area 3 of the NHLEP (Jeanne Schutt, personal communication concerning OCA excavations for the Las Cruces District in the NHLEP area in New Mexico).

Subsurface testing of each feature discovered during the intensive survey was undertaken subsequent to in-field analysis and mapping phases of the survey using a soil probe to estimate the dimensions of subsurface features at flagged locations. Testing was initiated in the immediate vicinity of each flagged feature and continued outward from the perceived center of the feature until no subsurface ash or ash-stained soil was encountered (Appendix B, Feature Form). The results of the survey and testing program include as many as 19 features discovered and examined in a single 400 x 400 meter survey unit.

The first section of this chapter describes 28 excavated features and artifacts recovered through excavation. Included in this section are summaries of radiocarbon dates obtained on charcoal and a comparison of these with results of the obsidian hydration analysis; a brief summary of macrofloral remains and pollen recovered from excavated features follows.

The next section of Chapter 9 compares the lithics and ceramics in feature assemblages with types of tested and excavated features. First, variation in the content of surficial lithic assemblages at features is identified with a cluster analysis which groups assemblages on the basis of similarities in lithic content. Then ceramics and features associated with lithic assemblage groups are compared in order to discern whether there are assemblage types that are consistently associated with different types of features. Comparisons between assemblage content and feature morphology demonstrate several correspondences between the types of assemblages associated with pit structures and larger tested features which will be detailed below.

This analysis constitutes a more systematic examination of artifact assemblages in the vicinity of features than can be accomplished solely with the excavation data. There are several reasons for using surface assemblage rather than excavation data in the analysis. In most cases, excavation was concentrated on feature definition and on sampling feature content rather than on extending excavated surfaces from features in order to recover associated artifactual materials. Since the actual surface of features and feature fill rarely contained artifactual material, little can be said of the nature of feature assemblages recovered from inconsistently arranged excavation units. It is unfortunate that more effort was not expended in excavating artifactual materials which provide clues to the functions and extent of feature reuse especially since comparison of surface and excavated assemblages, points to important differences in artifact size between the two. (See the final section of this chapter).

The comparison of surficial assemblages at features presented here does aid, however, in determining the content of assemblages which are more likely to be present at the locations of residential structures than at places containing other types of features. Final sections of Chapter 9 compare excavated artifact assemblages with the surface assemblages recorded during the Phase II intensive survey for differences in the size and types of items found in each.

All features discovered during the intensive survey in Units 45SE, 45SW, and 48NW were either tested for subsurface remains or excavated. Features in these units include pit structures, pits, and hearths as well as surficial distributions of FAR lacking subsurface deposits. Those for which testing indicated the presence of buried structures and features and that were subsequently excavated are described below. Some features in other survey units for which testing indicated the presence of a pit structure were also excavated. These include Feature 4 in Unit 50, Feature 5 in Unit 75, Feature 4 in Unit 21SW, and Features 1, 3, and 4 in Unit 48SW. A final hearth feature located in the proposed right-of-way of a recently installed AT&T telephone line, Feature 4 in Unit 21NE, was also excavated.

Excavated features in Units 21 and 45 are located on slightly elevated ridges and scarps bordered by deflation basins and populated by higher relief mesquite- and yucca-anchored coppice dunes. Mesquite coppice dunes also alternate with deflated interdunal surfaces in Units 50 and 75. Unit 50 borders a deflation basin and slopes gradually to the north, while Unit 75 essentially lacks relief. The topography of Unit 48 departs from one dominated by mesquite-anchored coppices grading from low-relief accumulations around soaptree yucca, for the most part, into a more continuous expanse of deep sand cover formed by an overlay of parabolic dunes.

EXCAVATED FEATURE DESCRIPTIONS

by John R. Roney and David C. Simons

Excavation Methods

A 1 meter grid was first established over each feature and all burned rock mapped in place. Loose surface sand (approximately 5 - 15 centimeters) was then removed using a shovel or trowel and screened through 1/8 inch mesh screen. Newly discovered burned rock was then added to the plan map. Features, in the form of ash and charcoal deposits, exposed by removal of surface sands were then photographed and mapped in plan view. Features, in the form of ash and charcoal deposits, exposed by removal of surface sands were then photographed and mapped in plan view. Features excavated by trowel were either bisected, with half of the feature excavated and the other half left intact, or were completely excavated. Soil, pollen, and charcoal samples were taken during excavation. Upon completion of the excavation plan and profile, maps were assembled and the excavation was photographed.

No subsurface deposits were found at several features. In these cases, burned rock was gathered and weighed on a platform scale by size category. Since no documentation in the form of plan maps or photographs was attempted, these features are considered "tested" and are listed in Table 9.13 along with excavated and other features tested during the Phase II survey.

Pit Structures and Associated Features

Unit 45SE - Feature 2

Feature 2 consists of a concentration of burned rock (FAR) and associated ashy deposit (2B), four distinct ash-filled pits (2A, 2C includes two pits, and 2E), a pit structure (2D) and a number of pockets of ash-stained soil, 13 of which were examined separately (Figure 9-2). These features are all within an area 7 meters x 6 meters in size.

Feature 2A is a circular, dish-shaped pit 70 centimeters in diameter filled with ash-stained sand and covered by a concentration of burned rock. The stain is moderately dark over an area 40 centimeters in diameter and 10 centimeters deep which seems to have escaped deflation due to the protective cover of burned rock. Very light gray sand surrounds the darker stain and measures 70 centimeters in diameter and 22 centimeters deep. Burned rock from Feature 2A is intermingled with burned rock from Feature 2B. Assigning FAR to each was arbitrarily resolved by designating burned rock in grids 3B, 3C, 4B, and 4C to Feature 2A and grids 5B, 5C, and 6B to Feature 2B. A total of 2,140 grams of burned rock were attributed to Feature 2A.

Feature 2B is a shallow basin of darkly stained soil about 50 meters in diameter which forms a 6 centimeters thick lens protected by burned rock. Lighter gray sand surrounds this deposit, forming an ash-stained surface with a diameter of about 140 centimeters and a depth of perhaps 10 centimeters. This feature could be a deflated remnant of a pit filled with ash and burned rock, or pit fill from elsewhere may have been deposited directly on the paleosol and preserved relatively intact. Burned rock attributed to this feature totaled 1,110 grams.

Feature 2C appears on the surface as a roughly circular outline of dark gray charcoal-bearing sand and blue-gray ash, 110 centimeters in diameter. It includes almost no burned rock. Inspection of trench profiles revealed two adjacent unlined pits; one positioned slightly above the other, both covered by a layer of ashy soil that extends over the surface of Feature 2D (Excavation Level 1). In profile, the southernmost pit is positioned at the northern lip of pit structure 2D and measures 90 centimeters in width. Pit fill contains charcoal and ashy soil for a depth of 20 centimeters. The northernmost pit is smaller, its profile 25 centimeters in width and 10 centimeters in depth, its fill indistinguishable from that of the ashy surface sand. Figure 9.2 illustrates the plan view of Feature 2C pits on excavation Level 2.

Feature 2D is a large very well-defined, ash-filled pit structure (Plate 9.1). The structure measures 170 centimeters to 190 centimeters in diameter and almost 30 centimeters deep. It is roughly circular in plan view and dish-shaped in cross section. It is filled with dark gray, charcoal-rich sand and has a blue-gray layer of ash resting on its floor. No burned rock was recovered from the structure fill or adjacent surface. On the floor of this feature in the southeastern quadrant is a small, circular

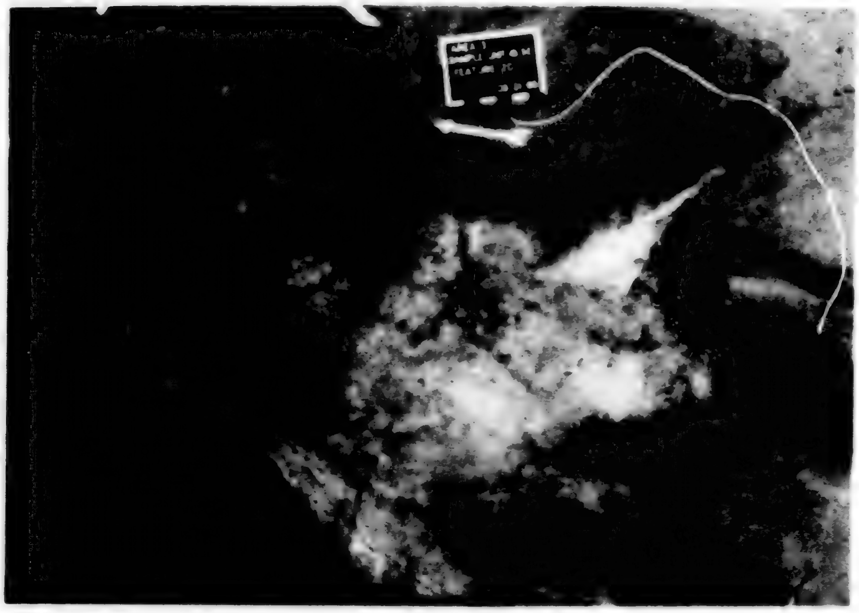


PLATE 9.1.

FEATURE 2D IN UNIT 45 AREA 3, A SHALLOW, SAUCER-SHAPED PITSTRUCTURE.

depression 10 centimeters deep and 25 centimeters in diameter. The depression had a rounded bottom and is filled with light gray sandy soil.

Feature 2E is an ash-filled pit which was subsequently excavated into the fill of Feature 2D, and therefore post-dates Feature 2D. It is oval in shape, 60 centimeters by 50 centimeters in size and 25 centimeters deep. The fill in this feature consisted of ashy, light gray sand which contained bits of charcoal, contrasting with the dark gray charcoal stained sand which fills Feature 2D. No FAR was contained within this feature.

In addition to these five major features, their encompassing surface is mottled with discontinuous charcoal staining. The darker, more concentrated pockets of charcoal stained soil were examined in cross sectioned and assigned feature numbers. These include:

Feature 2F--Lens of moderately dark ashy soil 41 centimeters x 36 centimeters and 5 centimeters deep.

Feature 2G--Pocket of medium gray ashy soil 20 centimeters x 16 centimeters and 6 centimeters deep.

Feature 2H--Lens of medium to dark gray ashy soil 20 centimeters x 15 centimeters and 7 centimeters thick.

Feature 2H--Lens of medium gray ashy soil 25 centimeters x 25 centimeters and 4 centimeters deep.

Feature 2J--Lens of light gray ashy soil 20 centimeters x 10 centimeters and 4 centimeters deep.

Feature 2K--Pocket of light gray ashy soil 15 centimeters x 15 centimeters and 9 centimeters deep.

Feature 2L--Lens of light gray ashy soil 20 centimeters x 15 centimeters and 4 centimeters deep.

Feature 2M--Very light gray surficial ash-stained surface 25 centimeters x 10 centimeters and 2 centimeters deep.

Feature 2N--Lens of medium gray ashy soil 60 centimeters x 20 centimeters and 5 centimeters thick. Within this stain is a 5 centimeter diameter limestone cobble which exhibited no obvious evidence of burning.

Feature 2O--Lens of medium gray ashy soil 25 centimeters x 12.5 centimeters and 8 centimeters deep. This feature includes a 2 centimeter diameter piece of charcoal.

Feature 2P--Medium gray ashy deposit 20 centimeters x 15 centimeters and 8 centimeters deep, possibly disturbed by rodent activity.

Feature 2Q--This dark ashy deposit is 20 centimeters x 8 centimeters and 4 centimeters deep. The size and shape of this feature suggest that it is a rodent burrow filled with sand from Feature 2C.

Feature 2R--This deposit of medium gray ashy soil also appears to be a rodent burrow filled with sand from Feature 2C. It is 28 centimeters long, 8 centimeters wide, and 6 centimeters thick.

Unit 45SE - Features 3, 7, and 15

Feature 3

Feature 3 consisted of a surface scatter of approximately 38 pieces of burned caliche with a total weight of 5,075 grams over an area 2.2 meters x 0.7 meters in size. The scatter also includes two fragments of groundstone. In the northern portion of the feature is a 10 centimeter diameter pocket of ash-stained soil 1 centimeter deep. Other features in the immediate vicinity include Features 7 and 15 (Figure 9.3).

Feature 7

Feature 7A is an oval pit, 50 centimeters x 35 centimeters in size, filled with ashy sand. In cross section it is a shallow basin 9 centimeters deep, and contains an area of potential disturbance extending to 15 centimeters below the surface. Fill in the feature includes a few very small pieces of charcoal. Feature 7B lies 20 centimeters to the northeast of Feature 7A. It is a small irregularly-shaped pit containing fill similar to that of Feature 7A, and measuring 30 centimeters in diameter. In cross section it is 6 centimeters deep and dish-shaped. Like Feature 7A it includes a few very small pieces of charcoal.

Feature 15

Feature 15 is represented by the remnants of shallow pit; in plan view it is an irregularly shaped, light to medium gray stained surface measuring 1.15 meters x 1.05 meters in size. The stain is 1 to 2 centimeters in depth. Adjacent to the feature on the east and west were two areas of light, caliche stained sand. These presumably represent rodent burrows. Five smaller pockets of lightly ash-stained soil ranging from 5 to 30 centimeters in maximum dimension were located to the north of Feature 15. This feature is large enough to be an eroded shallow pit structure.

Unit 45SE - Feature 8

Feature 8A consists of an eroded base of a pit 2.7 meters x 2.0 meters in size containing medium gray-brown sand. Because of possible post holes indicated by numerous small associated ash pockets, this feature may also be interpreted as the eroded remains of a shallow pit structure (Figure 9.4). The feature is a maximum of 15 centimeters deep. Within Feature 8A are two areas of very light gray-brown sand which are probably rodent disturbances and are labeled Features 8C and 8D. Also within Feature 8A were 13 darker pockets of ash-stained soil containing charcoal. These were labeled Features 8E, G, H, I, J, K, L, M, N, O, P, Q, and R. They range from 38 centimeters to 5 centimeters in maximum dimension and from 2 centimeters to 12 centimeters in depth. Four other small features, Features 8B, 8F, 8S, and 8T lie outside Feature 8A and range from 8 to 47 centimeters in maximum dimension and from 5 to 11 centimeters in depth. Eight of the smaller features may be post holes (8B, F, G, H, L, M, and R) which outline an area about 2 meters x 2 meters in size, correspondingly to the outline of Feature 8A.

Unit 45SE - Feature 13 and Unit 45SW - Features 3 and 4

Feature 13

Feature 13 appears to include the post hole outline and the interior hearth of a shallow pit structure and consists of a shallow dish-shaped pit filled with light gray ashy soil (Figure 9.5). The pit is oval in shape measuring 1.65 meters x 1.42 meters and 12 centimeters in depth. This lightly stained surface surrounds a much darker oval shaped pit containing charcoal and measuring 85 centimeters x 67 centimeters. The small pit is 30 centimeters deep, dish shaped, and includes a 10 centimeters thick lens of ash near its bottom. Around the perimeter of the larger, more shallow pit a number of small pockets of ashy sand were uncovered. Three of these were not post holes. However, the remaining nine do resemble post holes in that their fill is darkly stained by charcoal and has well-defined outlines. These post hole-like features outline an area 2.8 meters x 2.2 meters in size, more or less centered around the internal pit interpreted to be a hearth.

Feature 3

Feature 3 is a well-defined, circular, dish-shaped pit structure filled with ash and charcoal (Figure 9.6). The pit has a surface diameter of 140 centimeters. Very darkly stained ashy sand containing flecks of charcoal extends to a depth of 20 centimeters below the feature surface and a light gray ash-stained soil extends to a further depth of 10 centimeters.

Feature 4

Feature 4 consists of light gray surficial ash stain which contains 7 areas of medium gray stain and 12 pockets of more darkly stained soil (Figure 9.7). These range from 10 centimeters to 35 centimeters in diameter and from 2 to 7 centimeters in depth. The large, very faint stain which surrounds these darker nodes is 2.9 centimeters x 2.2 centimeters in size. Like Feature 13A in Unit 45SE, this feature may be the eroded base of a small pit structure.

Unit 45SE - Feature 17

This feature is a possible pit structure measuring 150 centimeters x 130 centimeters and 3 to 4 centimeters deep (Figure 9.8). Within the perimeter of ash-stained fill of the feature are several pockets of darker gray sand. One of these, Feature 17C, is 28 centimeters x 12 centimeters in size and about 8 centimeters deep. Also within the larger stain is Feature 17D, which is 36 centimeters x 26 centimeters in size and 3 centimeters deep. Feature 17B lies just outside the larger pit. It is 31 centimeters x 24 centimeters in size and 8 centimeters deep. Unlike other portions of this feature, Feature 17B includes some specks of charcoal. A few widely scattered pieces of burned rock in the vicinity of the feature were not located within the excavation grid.

Unit 48NW - Feature 5

Feature 5 is interpreted as the eroded, disturbed base of a shallow dish-shaped pit structure containing dark gray ashy sand flecked with charcoal. Figure 9.9 illustrates a plan view of the ash-stained surface of the feature and smaller pockets of ashy soil (Features 5B, 5C, and 5D.) In profile, the feature appears larger than in plan view due to a greater contrast between feature fill and the red-brown paleosol into which the structure was excavated. In profiles, the features measures 150 centimeters in diameter and 25 centimeters at its greatest depth.

Unit 48SW - Features 1, 3, AND 4

This complex of features is situated on a deflated surface protected on the east by a mesquite/soaptree yucca coppice dune and bordered on the north and west by continuous low-relief sand dunes anchored primarily by soaptree yucca. Plate 9.2 views the excavation from the northwest.

Feature 1

Feature 1 is a pit structure measuring 225 centimeters in diameter with a maximum depth of 42 centimeters as measured in the profile of the north-south test trench bisecting the feature (Figure 9.10). The perimeter of the feature proved difficult to define during excavation due to the similar appearance of very lightly stained sand composing the feature fill and the surface into which the feature was excavated. The western half of the feature was excavated. No interior features were detected in the excavated portion of the feature.

Feature 3

Feature 3A is a pit structure roughly circular in shape measuring 180 centimeters north-south by 173 centimeters east-west with a maximum depth from surrounding paleosol in 6 centimeters (Plate 9.3, Figure 9.11). A round-bottomed rimless pit, 32 centimeters in diameter and 6 centimeters deep is located in close proximity of the feature. The single artifact retrieved in direct floor contact was a rhyolite hammerstone. Eleven post holes were defined along the exterior edge of the structure and three along the western interior edge. An additional two shallow sockets were located in the southern third of the structure. The structure entrance as indicated by alignments of post holes arranged in a rough rectangle is to the east of the structure.

Feature 4

Feature 4A is a rectangular pit structure (Plate 9.4, Figure 9.12), the maximum dimensions of which are 231 centimeters north-south and 197 centimeters east-west. The maximum depth of the structure is 17 centimeters. A central interior hearth circular in outline measures 44 centimeters in diameter and is 8 centimeters in depth from the feature floor. Artifacts recovered from the feature floor include four pieces of carbonate and one piece of noncarbonate FAR and a small sherd of El Paso Brownware. The upper fill contained additional sherds and lithics. Burned matted grass stems and pieces of yucca stalk recovered from the lower fill and floor are probably materials used in roof construction. Post holes defined along the exterior and interior of the pit also defined a rectangular entryway between 65 and 66 centimeters in length extending from the southeastern edge of the pit structure. The inferred entry outline measures 84 centimeters wide at its farthest extension and 46 centimeters wide where it meets the main structure.

Located about 2 meters south of Feature 4A, Feature 4B (Figure 9.13) is a shallow basin-shaped pit measuring 104 centimeters in diameter filled with darkly ash-stained soil. Twelve possible post holes were defined aligned in a semi-circular pattern around the southern, western, and eastern ends of the feature suggesting a wall constructed as a windbreak. Several small pieces of FAR lie along the southwestern edge the feature.

Unit 50 - Feature 4

Excavation of the eastern half of Feature 4 (Plate 9.5) revealed a roughly circular shallow pit structure 20 centimeters deep (Figure 9.14). Interior dimension of the structure are 224 centimeters north-south by 216 centimeters east-west. Eight possible post holes aligned along the inner periphery of the pit range in depth from 3 to 9 centimeters. No artifacts were recovered from the feature surface or from the interior fill. No interior features other than the post holes were located in the excavated portion of the feature.

Unit 75 - Feature 5

Feature 5A is a flat-bottomed circular pit structure (Figure 9.15) the surface of which is 225 centimeters in diameter in plan view. The western half of the structure was excavated (Plate 9.6). Interior dimensions of the excavated portion of the structure are 195 centimeters north-south and are estimated at 165 centimeters east-west. Located to the north and northwest of the structure are two exterior hearths. Feature 5B is a circular bowl-shaped hearth which measures 65 centimeters in diameter and is depth deep in profile. Feature 5D is oval in plan view and bowl-shaped in cross section. This feature measures 118 centimeters in diameter and 18 centimeters deep. Features 5C and 5E were

PLATE 9.2.

VIEW FROM THE NORTHWEST OF FEATURES 3 AND 4 IN UNIT 48.

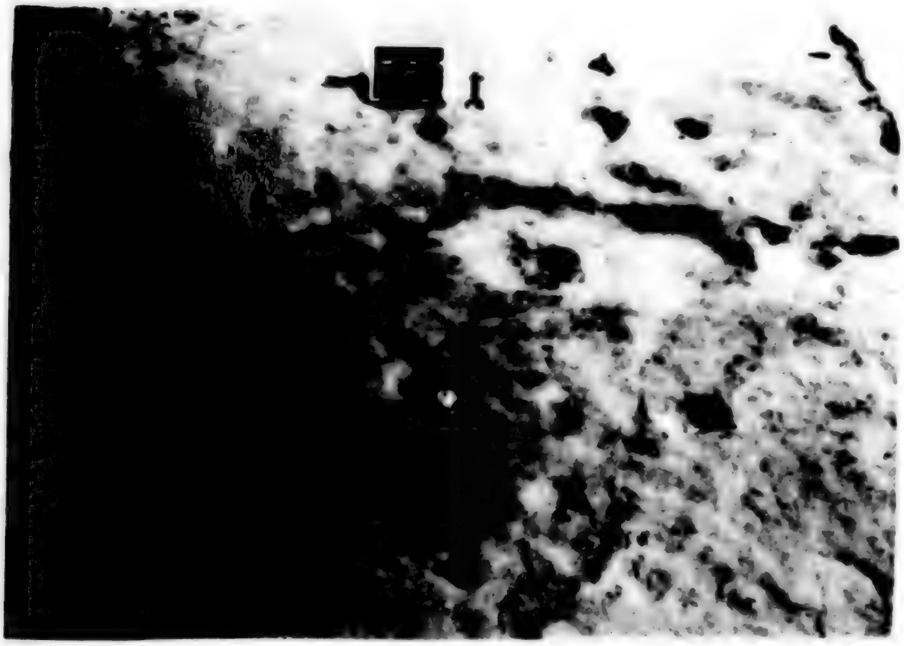


PLATE 9.3.

STRUCTURE FLOOR OF FEATURE 3A IN UNIT 48, AREA 3.

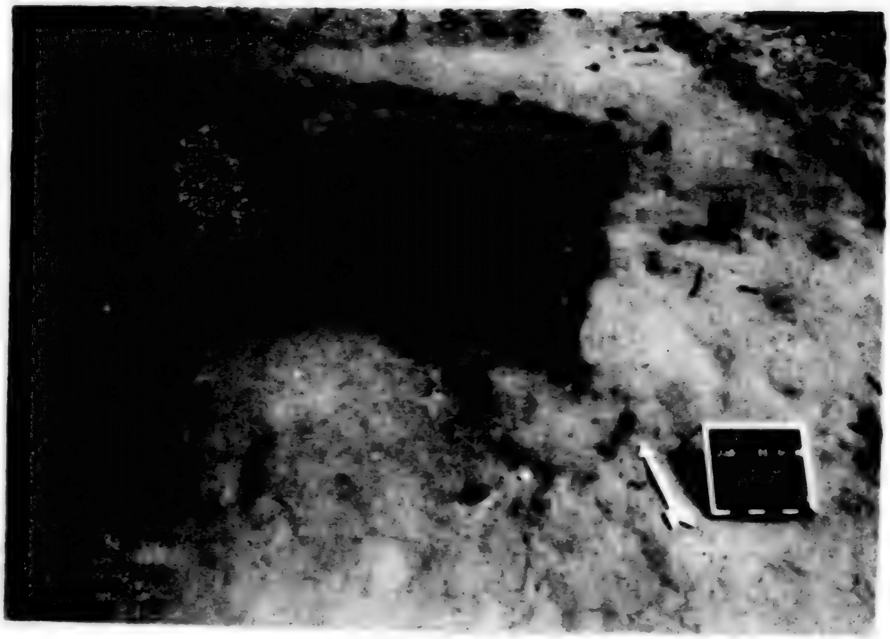


PLATE 9.4.

FEATURE 4A IN UNIT 48 AREA 3, RECTANGULAR PITSTRUCTURE.

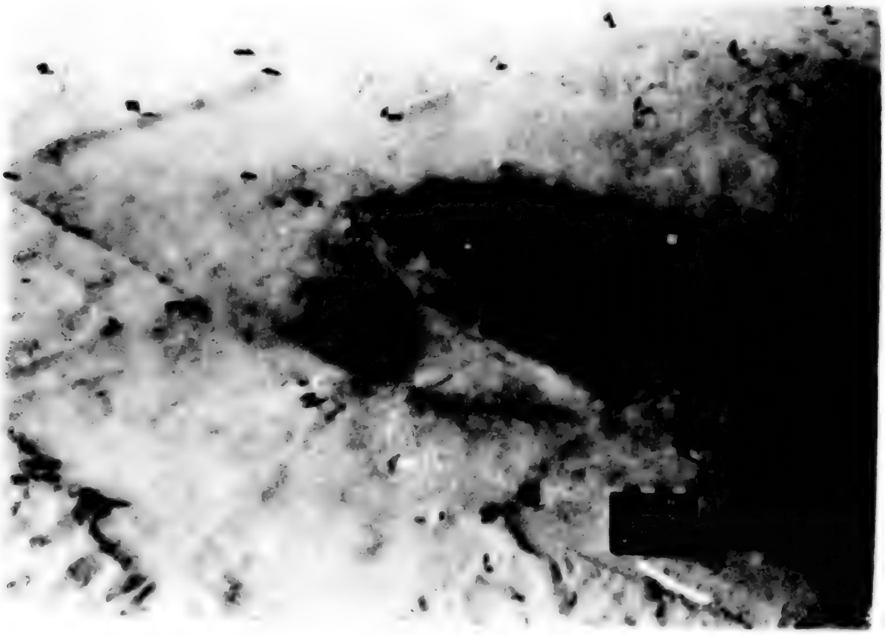


PLATE 9.5.

FEATURE 4 IN UNIT 50 AREA 2, CIRCULAR PITSTRUCTURE.

PLATE 9.6.

FEATURE 5 IN UNIT 75 AREA 2,
EXCAVATED HALF OF OVAL
PITSTRUCTURE.

314

determined to be the ash-stained fill of eroded rodent burrows.

Unit 21SW - Feature 4

Excavations at Feature 4, Provenience 1 revealed a large, irregularly shape pit structure measuring 290 centimeters east-west and 265 centimeters north-south (Figure 9.16). The average depth of the structure is 30 centimeters from the paleosol surface. A shallow circular pit dug into in the floor of structure is 100 centimeters in diameter and 8 centimeters deep. A single post hole was encountered and pedestaled during excavation. Provenience 2 includes a shallow saucer-shaped depression, 90 centimeters in diameter with a depth of 7 centimeters located 4 meters to the south of the pit structure.

Hearths and Pits

Unit 48NW - Features 2 and 3 (Figure 9.17)

Feature 2

Feature 2 includes 54 pieces of burned rock, predominantly caliche, with a total weight of 2,870 grams scattered over an area approximately 3 meters in diameter. Removal of surface sands revealed a series of light to medium gray surface stains situated immediately west of the burned rock distribution. The six largest and darkest stains were designated Features 2A through 2F.

Feature 2A is a very faint gray lens of ashy soil measuring 75 centimeters x 70 centimeters in size and generally less than 2.5 centimeters in depth. However, one 4 centimeter diameter area within this stain is darker, contained a few tiny specks of charcoal, and is 7 centimeters deep.

Feature 2B is a light gray stain 40 centimeters x 30 centimeters in size, and oval in shape. In profile, the stain is about 3 centimeters thick and lens shaped.

Feature 2C is a small, light gray stain 20 centimeters x 15 centimeters in size and approximately 4 centimeters deep.

Feature 2D is a very light gray stain, extremely irregular in shape, and limited for the most part to the surface of the paleosol. Maximum extent of the feature is 165 centimeters x 80 centimeters, but the shape of this stain suggests that it has been expanded as a result of rodent disturbance.

Feature 2E is characterized by darker, well consolidated sand surrounding small pockets of coarse, white sand.

Feature 2F is an oblong 30 centimeter x 12 centimeters stain which is 5 centimeters deep. Although light gray in color, this feature did include several flecks of charcoal.

Feature 3

Feature 3A is a relatively large, medium to very light gray ash-stained deposit, 60 centimeters x 50 centimeters in size, and no more than 9 centimeters deep. Surrounding Feature 3A were 12 smaller deposits of ash-stained soil, which form no discernible pattern. Three of these smaller stains were excavated. Feature 3B is a light gray stain 18 centimeters x 10 centimeters in size and 8 centimeters deep. Feature 3C is a light gray ash-stained deposit 14 centimeters x 8 centimeters in size and 6 centimeters deep. Feature 3d is also light gray in color and is 28 centimeters x 13 centimeters in size and 4 centimeters deep.

Unit 48NW - Feature 6

Feature 6 is a shallow pocket of ash-stained soil which becomes a light, irregularly shaped surficial ash stain loose surface sand (Figure 9.18); the feature appears slightly humped or mounded in profile. The feature fill was flecked with charcoal but contained no FAR, nor did the feature surface include any FAR.

Unit 45SE - Features 4 and 14 (Figure 9.19)

Feature 4

Feature 4 consists of a scatter of burned rock centered over charcoal stained soil, probably representing the floor of a deflated pit. The burned rock scatter includes approximately 140 pieces of FAR scattered over an area 4 meters x 3 meters in size, with a total weight of 12.035 kilograms. Beneath the burned rock scatter is the oval floor of the pit measuring 60 centimeters x 45 centimeters. The feature fill is dark to medium gray in color and is 4 centimeters thick. The mounded deposit, slightly higher than the surrounding deflation surface when excavated from the loose surface sand, may have been protected somewhat by the overlying burned rock.

Feature 14

Feature 14 is located about 1.5 meters from Feature 4 and is a small, shallow pit that did not contain burned rock measuring 45 centimeters x 50 centimeters. Several smaller pockets of grayish sand were recorded at Feature 14:

Feature 14A - a small, shallow ash stain which may be the deflated remnant of a feature which is originally larger. Presently, the feature consists of a dark gray stain 25 centimeters in diameter and up to 8 centimeters deep surrounded by a lighter gray stain which is 50 centimeters in diameter and up to 22 centimeters deep. Both of these zones have migrated downward along shrinkage cracks, however, and original depth of the dark stain may be no more than 3 or 4 centimeters below the present surface.

Feature 14B - a small, 10 centimeters diameter, 3 centimeters deep pocket of dark gray sand.

Feature 14C - a light gray stain 16 centimeters by 15 centimeters in size and 2.5 centimeters deep.

Feature 14D - a 5 centimeter diameter surface stain with no depth.

Feature 14E - a 4 centimeter diameter surface stain.

Feature 14F - also a 4 centimeter diameter surface stain with no depth.

Unit 45SE - Feature 5

Feature 5 is a small pit filled with charcoal stained sand and burned rock (Figure 9.20). On the surface are about 75 pieces of burned rock in an area approximately 1.5 meters in diameter. This scatter is tightly centered over a small circular pit 55 centimeters in diameter and 10 centimeters deep, with a dish-shaped cross section. Fill in the pit is dark to medium grey in color and includes 47 pieces of burned rock. Total weight of burned rock associated with the feature is 6,145 grams.

Unit 45SE - Feature 10

Feature 10 is a well-defined pit filled with dark gray sand, including a lens of charcoal mixed with sand (Figure 9.21). In plan view, the feature is oval shaped, 80 centimeters x 60 centimeters in size. The stratigraphic profile of this feature shows it to be 30 centimeters deep, with the zone of maximum charcoal between 10 and 25 centimeters below the surface. The cross section is bowl shaped and feature walls are vertical or perhaps even overhanging near the surface. No burned rock is associated with this feature.

Unit 45SE - Features 11, 12, and 16

Feature 11

This feature consists of a medium-sized pit and four smaller pockets of charcoal-stained sand (Figure 9.22). The larger pit measures 90 centimeters x 70 centimeters and 5 centimeters deep. Its fill consists of light gray sand which is difficult to distinguish from the underlying paleosol. Presumably, this is the deflated remnant of a larger feature. The small pockets of stained soil consists of:

Feature 11B - gray ash-stained sand with charcoal flecks 7 centimeters in diameter and 2 centimeters thick.

Feature 11C - a root stain 6 centimeters in diameter and 4 centimeters thick.

Feature 11D - also interpreted as an organic stain 9 centimeters in diameter and 2.5 centimeters thick.

Feature 11E - an ashy stain with some charcoal flecks, 1.5 centimeters thick and 2.5 centimeters in diameter.

Feature 12

Feature 12 is a very well-defined pit dug into paleosol (Figure 9.23). The pit is cylindrical, with a circular plan measuring 165 centimeters in diameter and 45 centimeters deep. The walls are perpendicular, or perhaps even slightly undercut, so that the floor diameter of the feature is larger than that of its surface perimeter. The floor of the pit is relatively flat, but there is a 7 centimeters difference between depth at the edge and the middle of the feature. Directly on the floor of the feature is a blue-gray layer of ash about 5 centimeters thick interspersed with charcoal, the presumed remains of a bed of coals. Overlying this stratum is larger light gray, fairly loose sand which also contains large chunks of charcoal.

Feature 16

This shallow feature consists of a dark deposit of charcoal-stained sand in a shallow pit 50 centimeters in diameter, surrounded by a lighter gray stain 150 centimeters x 125 centimeters in size (Figure 9.22). The darker fill is less than 7 centimeters thick, but some charcoal discoloration has clearly migrated along shrinkage cracks and perhaps rodent burrows to expand both the horizontal and vertical extent of this feature. Feature 11 is located less than 1.5 meters east of this feature.

Unit 45SE - Feature 18

Feature 18 is a deep, bowl-shaped pit filled with dark, ash-stained soil (Figure 9-24). In plan view, the feature is circular, 1 meter in diameter and 35 centimeters deep. A mass of charcoal almost 20 centimeters deep occupies the bottom of the pit. Ten other small ash stains were also excavated. These smaller features range from 8 centimeters to 22 centimeters in diameter and are between 4 centimeters and 16 centimeters deep. Nine of these features are interpreted as post holes, although they form no discernible pattern in relation to the hearth. The tenth is an 8 centimeter diameter, 13 centimeter deep hole dug into the bottom of Feature 18A.

Unit 21NW - Feature 4

The disturbed remnants of a basin-shaped hearth comprise Feature 4 (Figure 9-25). Maximum dimensions of the feature as shown in profile are an 85 centimeters east-west diameter and a depth of 11 centimeters. Feature fill includes a gray/black ash and charcoal stained soil. A rodent burrow bisects the feature.

RADIOCARBON DETERMINATIONS

Radiocarbon dating was not used here to correlate excavated strata between sites or spatially discrete portions of sites. Charcoal samples retrieved from the fill of pit structures, pits, and hearths were essentially positioned within the same stratum, a compact interdunal paleosol surface paved with lag gravels. Of the 28 features excavated, 12 yielded sufficient charcoal for radiocarbon dating. Charcoal proved to be lacking or extremely sparse in the fill in the remaining features.

The 26 radiocarbon dates obtained are listed in Table 9.1. Samples were submitted to Dr. Murry Tamers of Beta Analytic, Inc. Five small samples weighing less than 1 gram were given extended counting time for four times the normal period for maximum practical reduction of statistical error, and four very small samples weighing less than 0.3 gram were processed using a particle accelerator technique. The radiocarbon dates in years B.P. are based on the Libby value of 5,689 years taken for the half-life of radiocarbon. Corrected B.C./A.D. dates were calculated using the calibration tables offered by Klein and others (1982). Using these tables, corrected dates were rounded to the nearest 5 years.

The most recent dates obtained for each of seven pit structures and one feature interpreted as a possible pit structure span the period between 2310 B.C. and A.D. 1060. The earliest dated structure is Feature 2D in Unit 45SE. The surface of this feature measured 68 centimeters below vertical datum and the maximum depth of the structure floor 93 centimeters below datum. Dates on two charcoal samples from the lower fill of the structure at 72 centimeters below datum and from an excavated level between 70 and 80 centimeters below datum place the use of this feature between 2490 and 2310 B.C. An additional sample taken from a pocket of charcoal rich fill 70 to 80 centimeters below datum dated to 3115 ± 255 B.C. Feature 2C, an extramural pit/hearth positioned on the northern edge of the pit structure yielded a date of 220 ± 180 B.C. Although not superimposed upon Feature 2D, the hearth feature 2C may have been used at a much later time. Other evidence for the reuse of the vicinity of the pit structure comes from Feature 2E, an undated hearth that was excavated into the fill of pit structure 2D (Feature 2D).

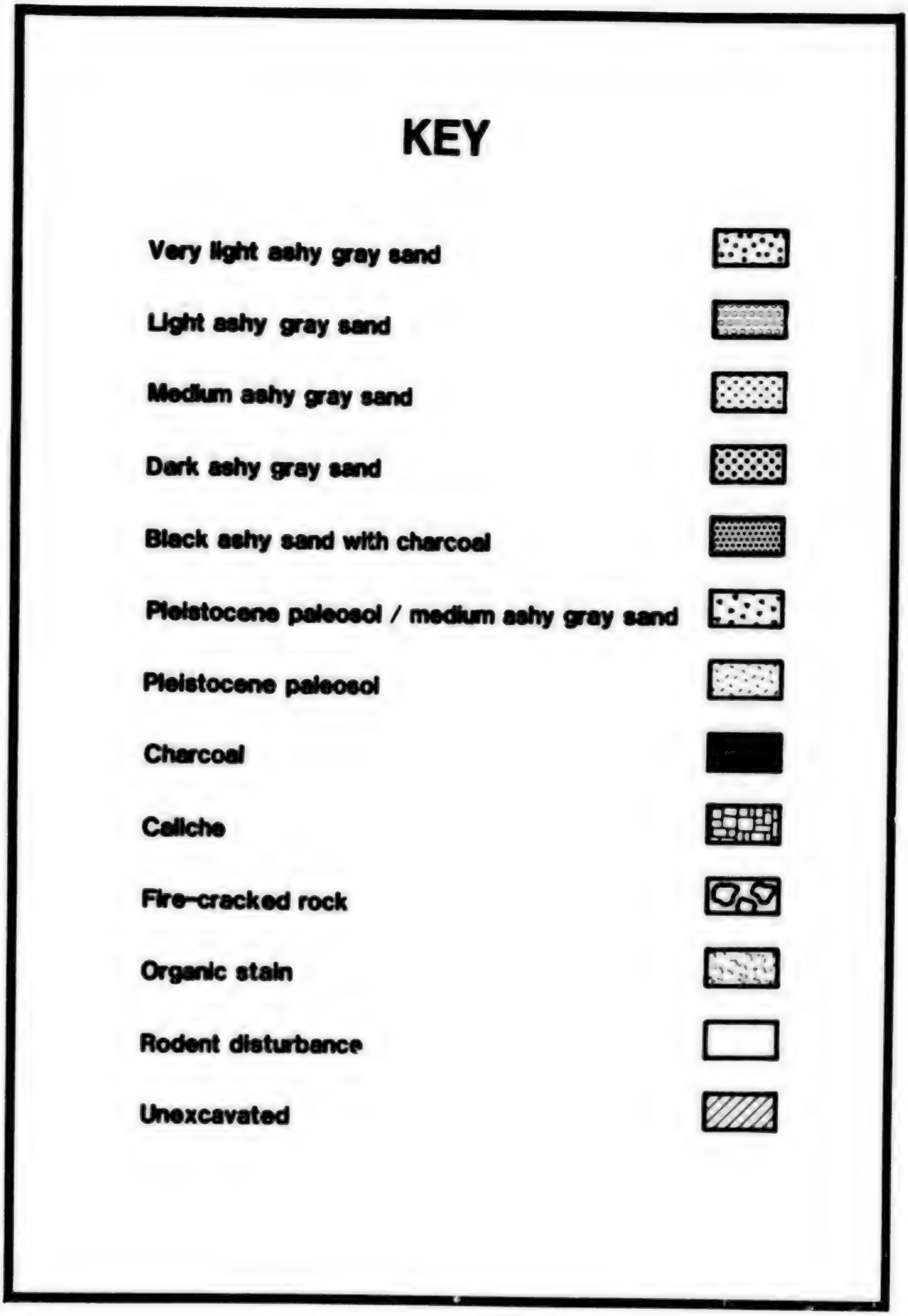


FIGURE 9.1.
KEY FOR EXCAVATION MAPS.

I 53.2:AR 2/5

DISTRIBUTIONAL SURVEY & EXCAVATION OF
ARCHAEOLOGICAL LANDSCAPES IN THE VICINITY
OF EL PASO, TEXAS... U.S. DEPARTMENT OF
THE INTERIOR... OCTOBER 1988

5 OF 7
24X
SUPTDOCS/GPO
P.0319-0396

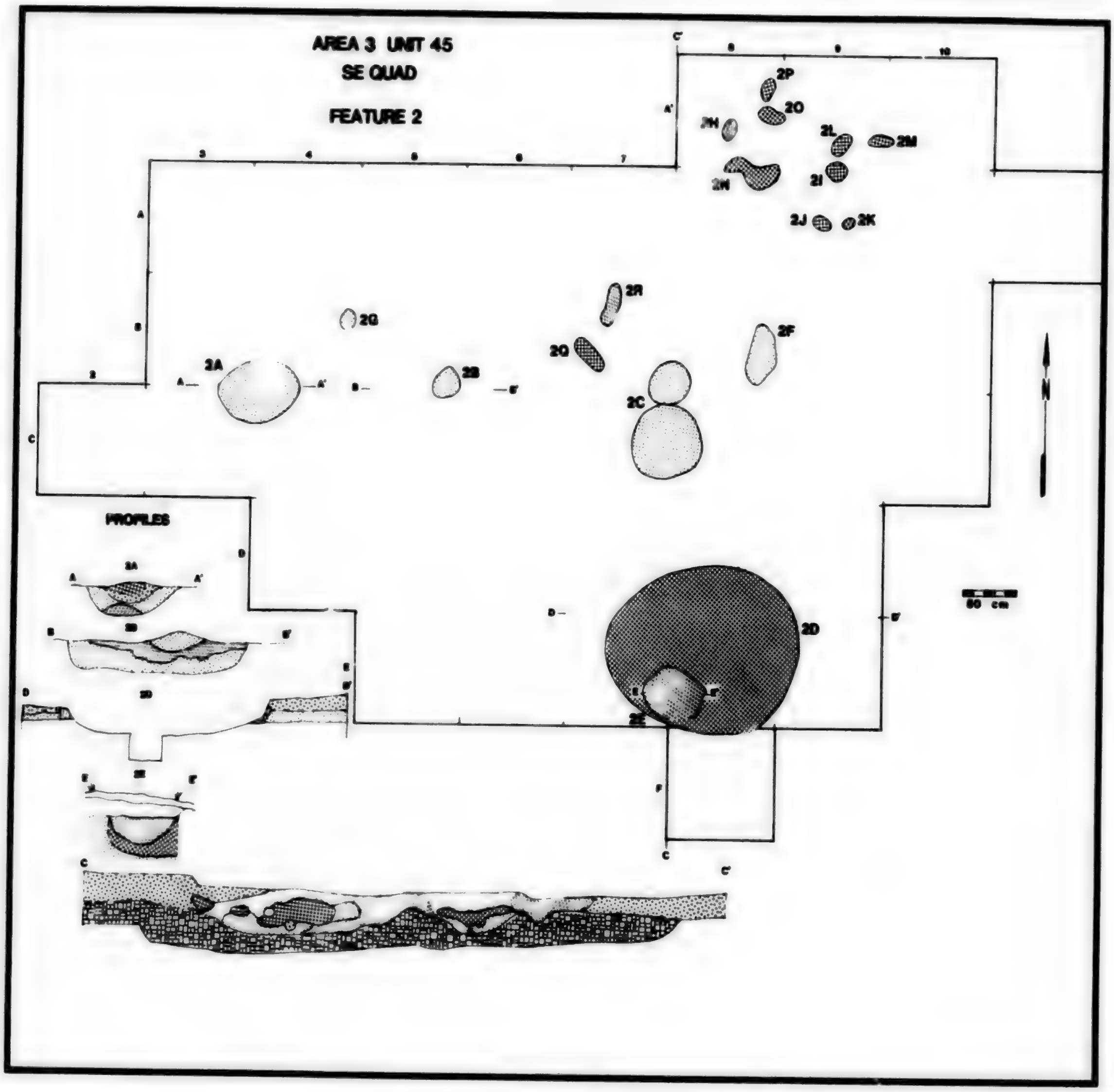


FIGURE 9.2.
FEATURE 2 IN UNIT 45SE.

BLANK

PAGE

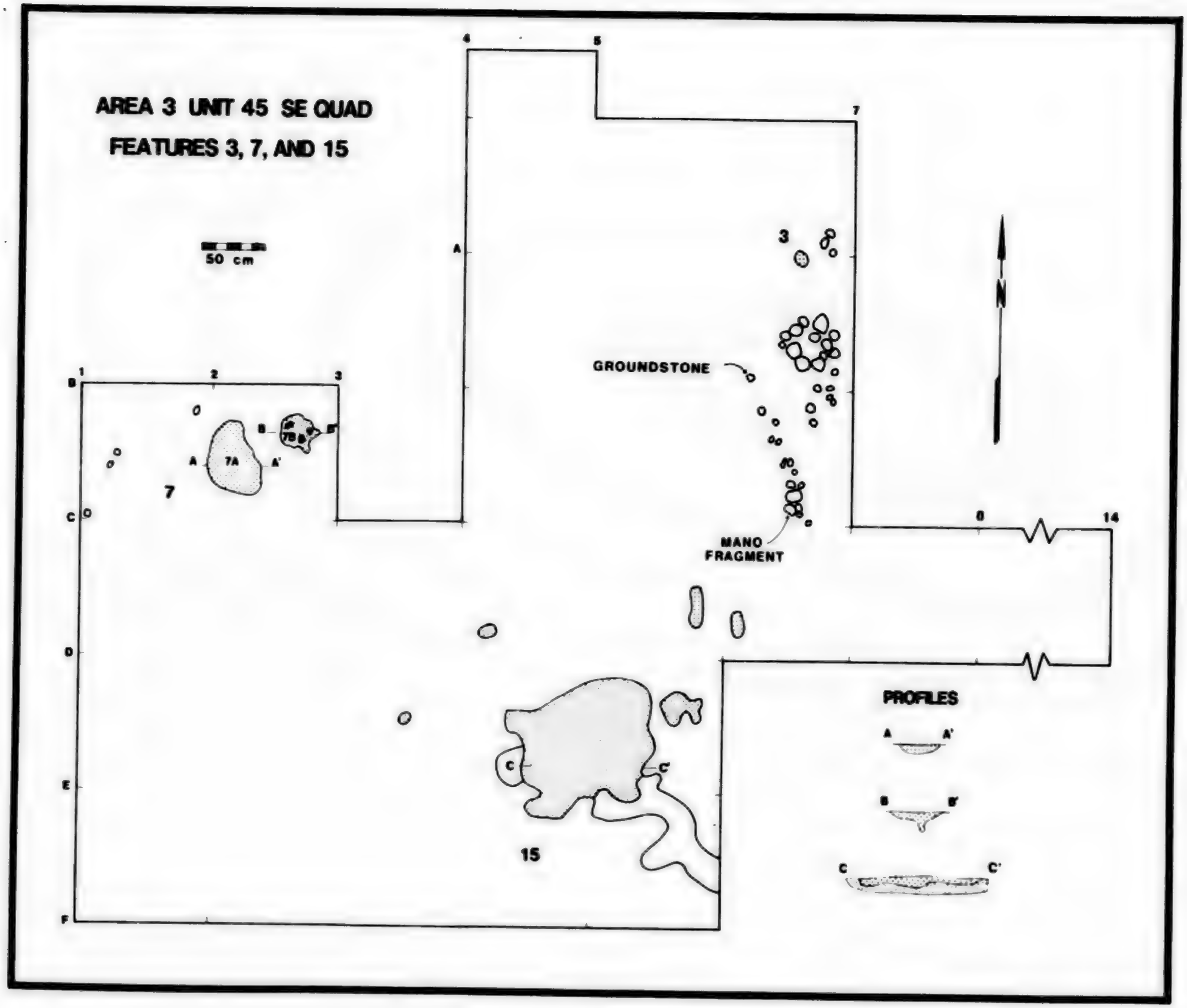


FIGURE 9.3.
FEATURES 3,7 AND 15 IN UNIT 45SE.

320

320

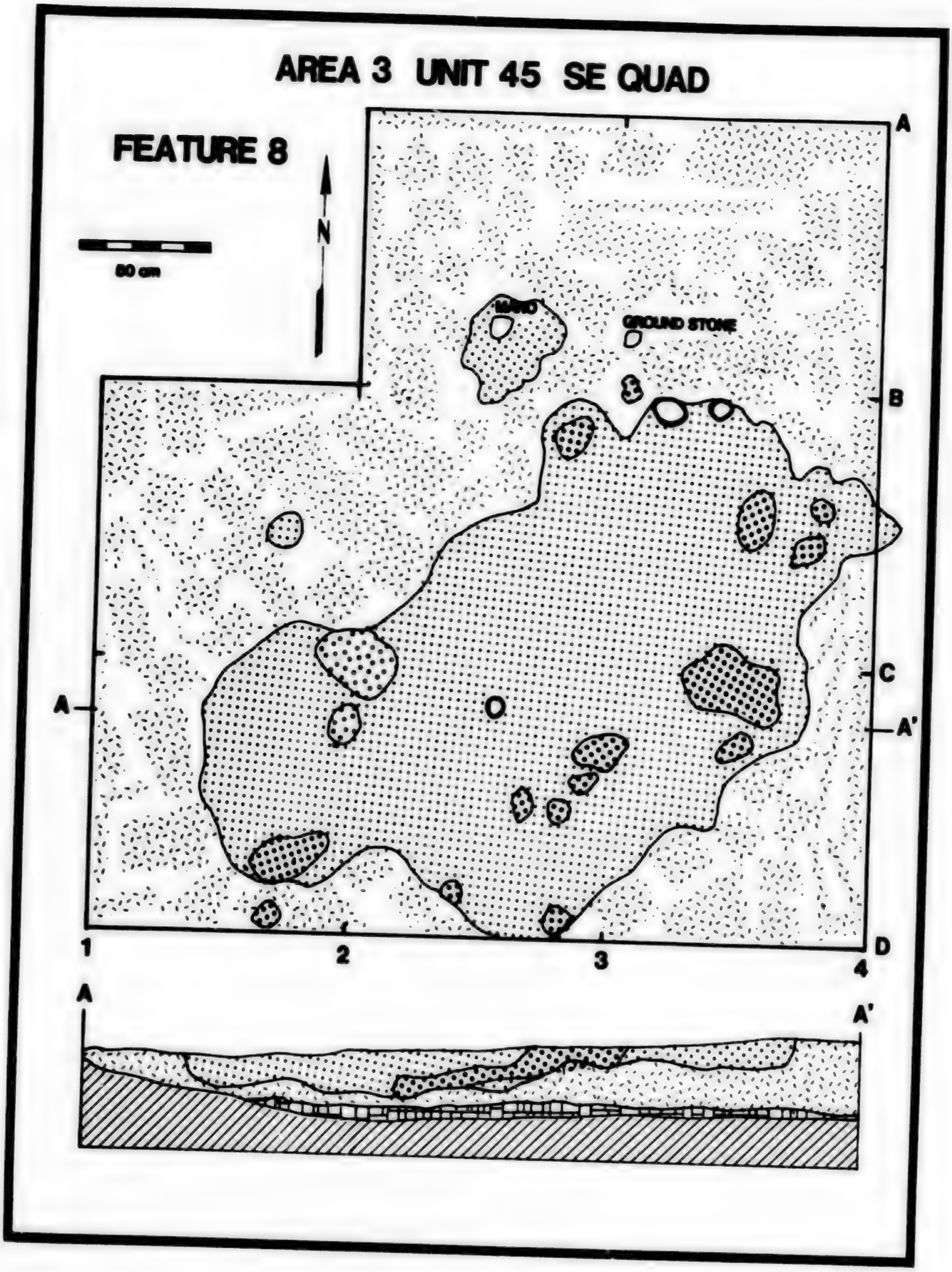


FIGURE 9.4.
FEATURE 8 IN UNIT 45SE.

321

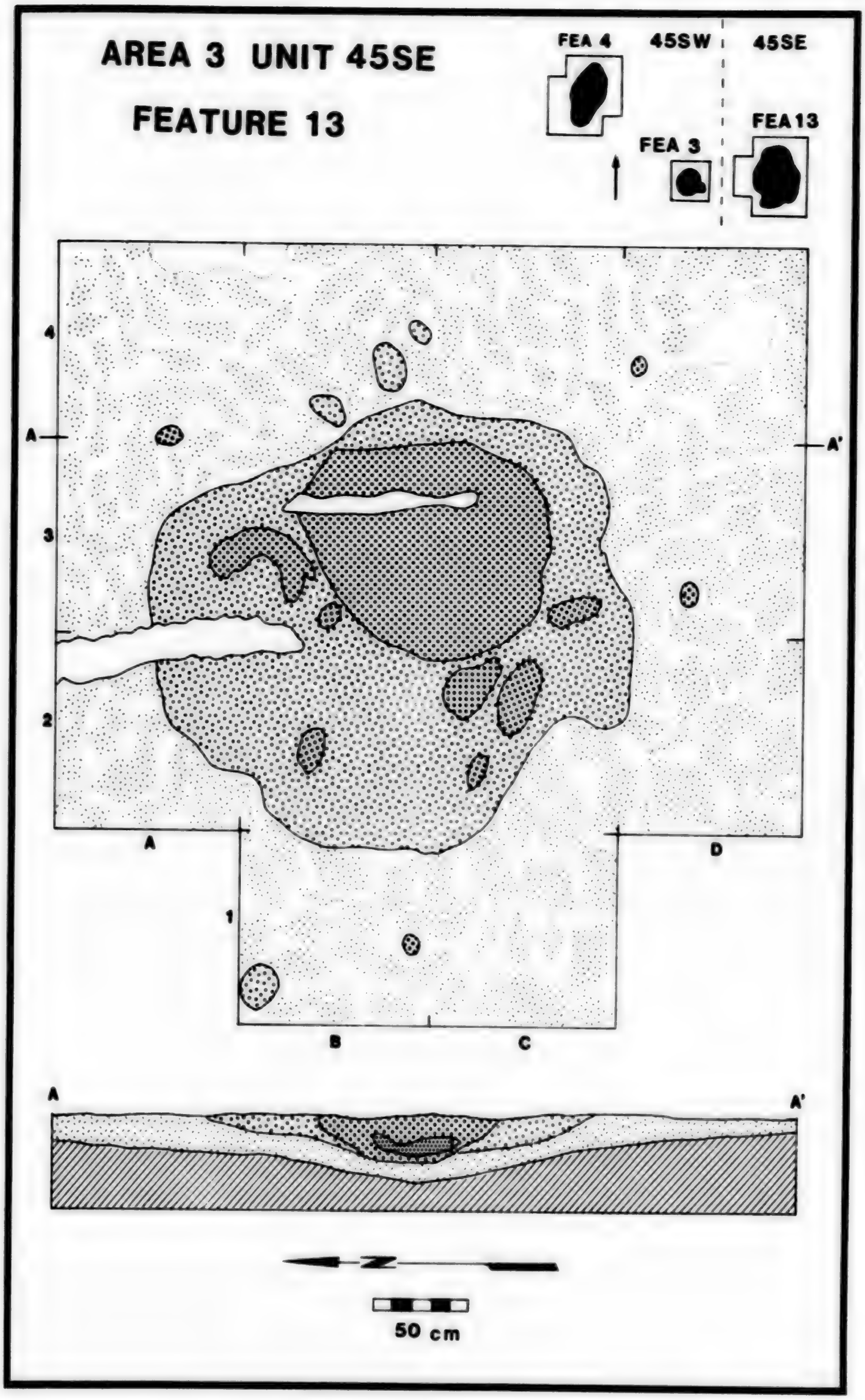


FIGURE 9.5.
FEATURE 13 IN UNIT 45SE.

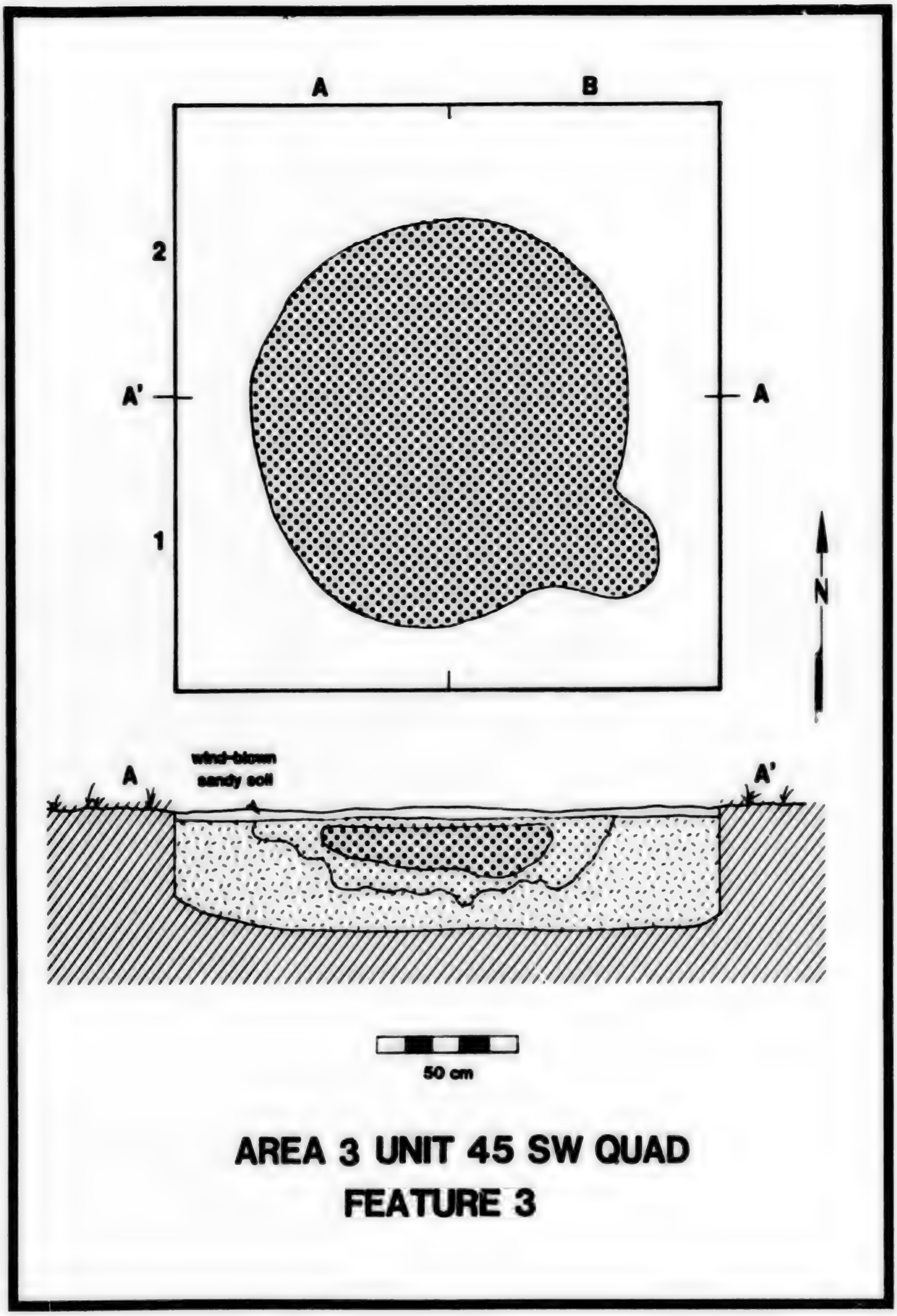


FIGURE 9.6
FEATURE 3 IN UNIT 45SW.

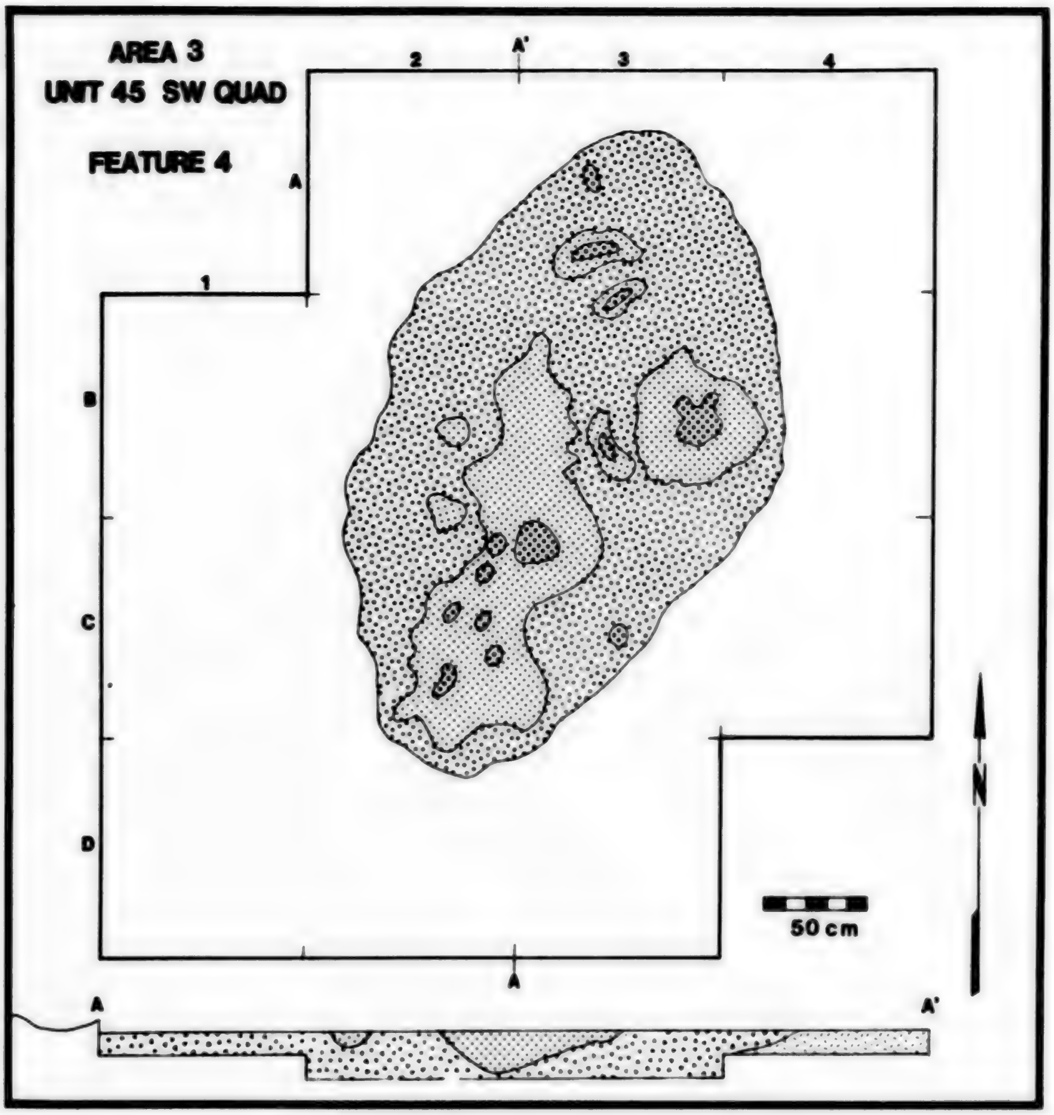


FIGURE 9.7.
FEATURE 4 IN UNIT 45SW.

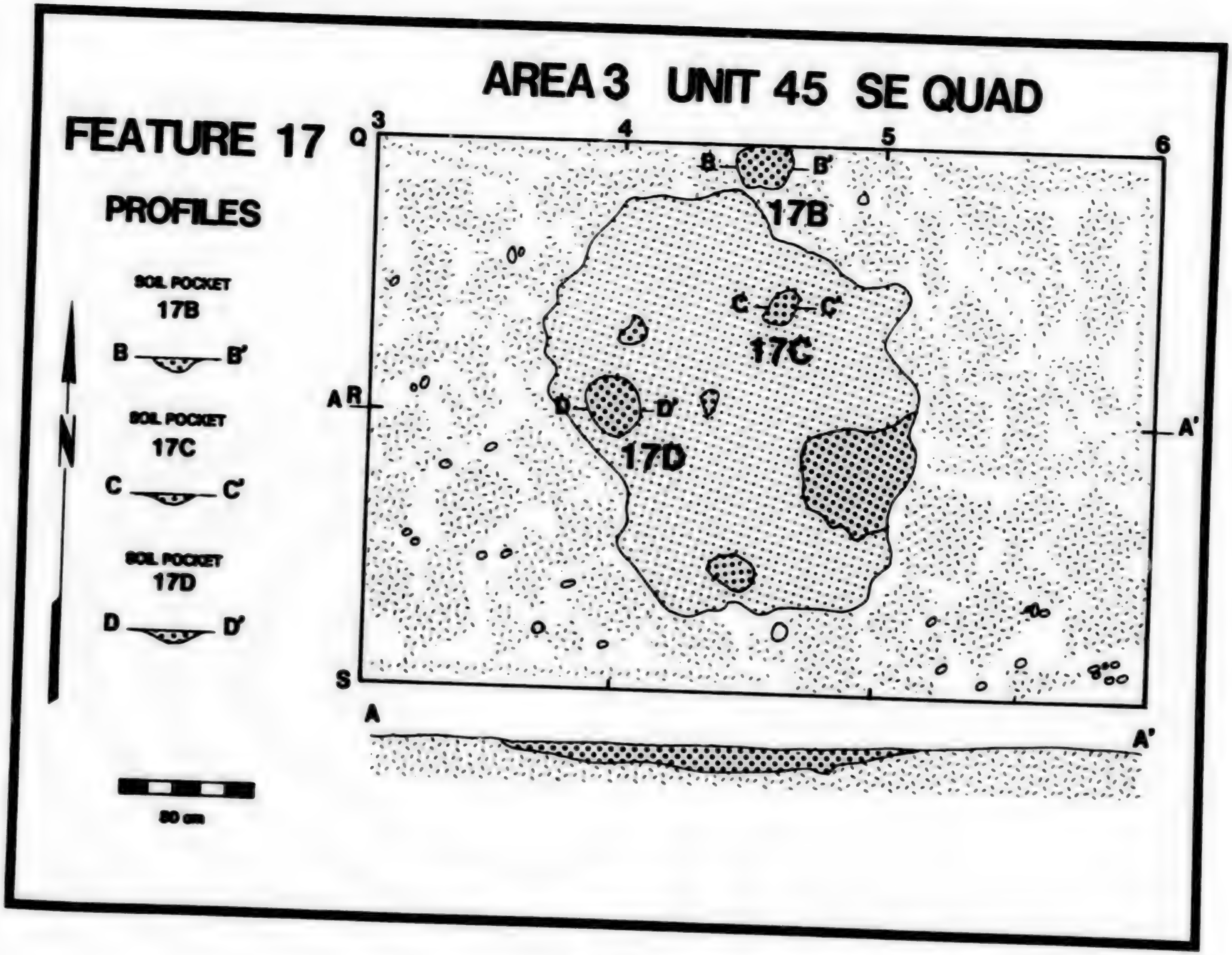


FIGURE 9.8.
FEATURE 17 IN UNIT 45SE.

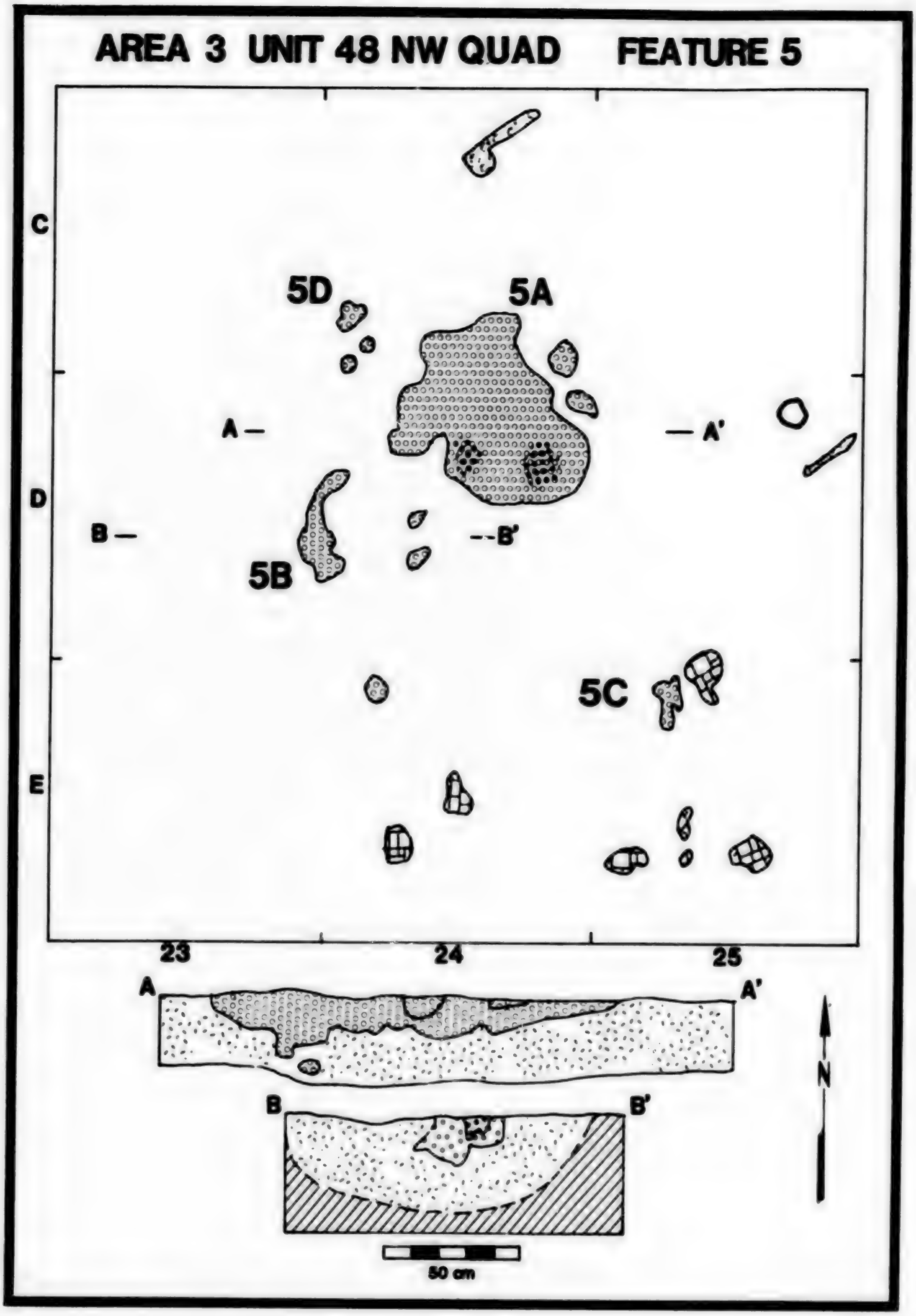


FIGURE 9.9.
FEATURE 5 IN UNIT 45SE.

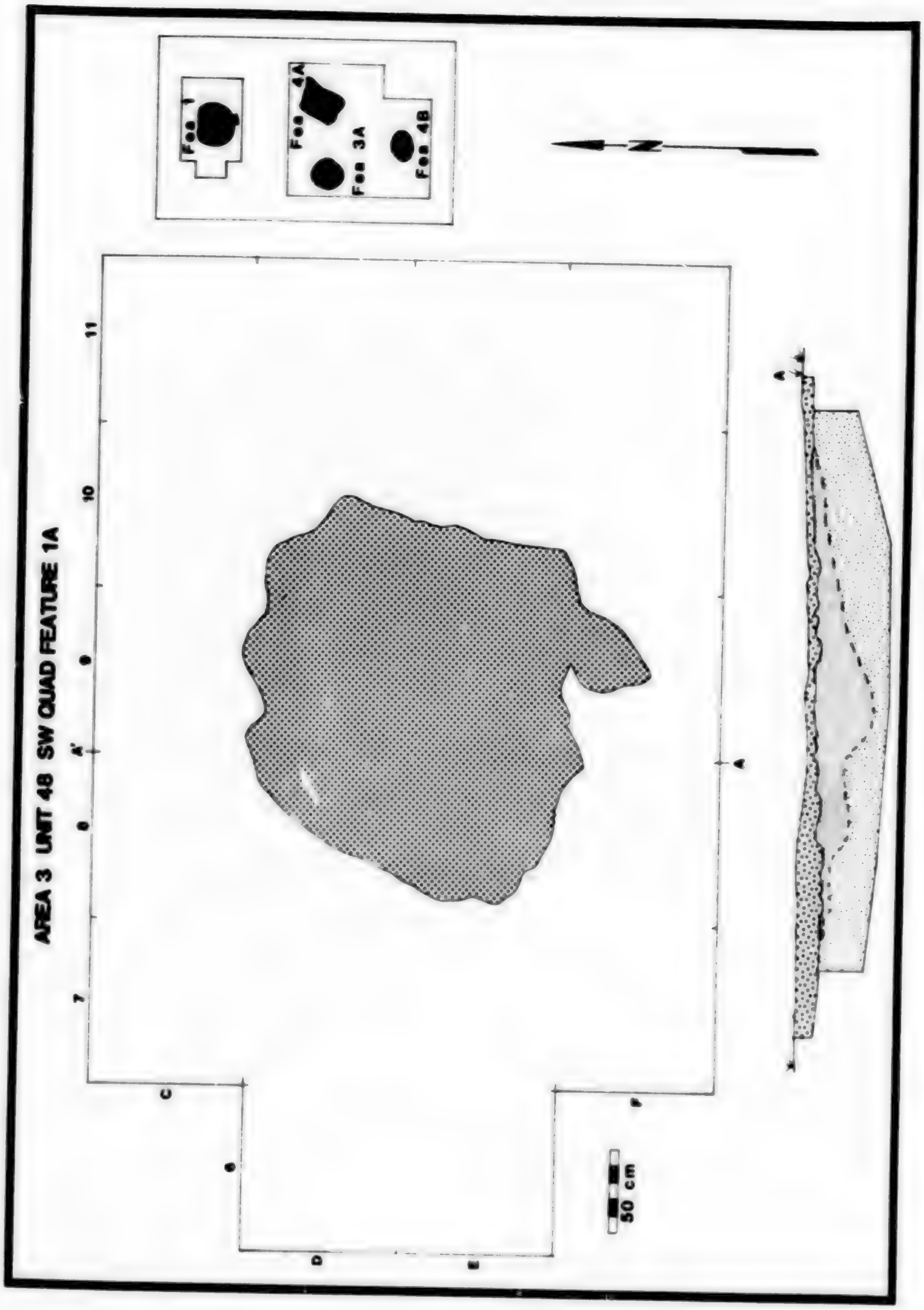


FIGURE 9.10.
FEATURE IA IN UNIT 48SW.

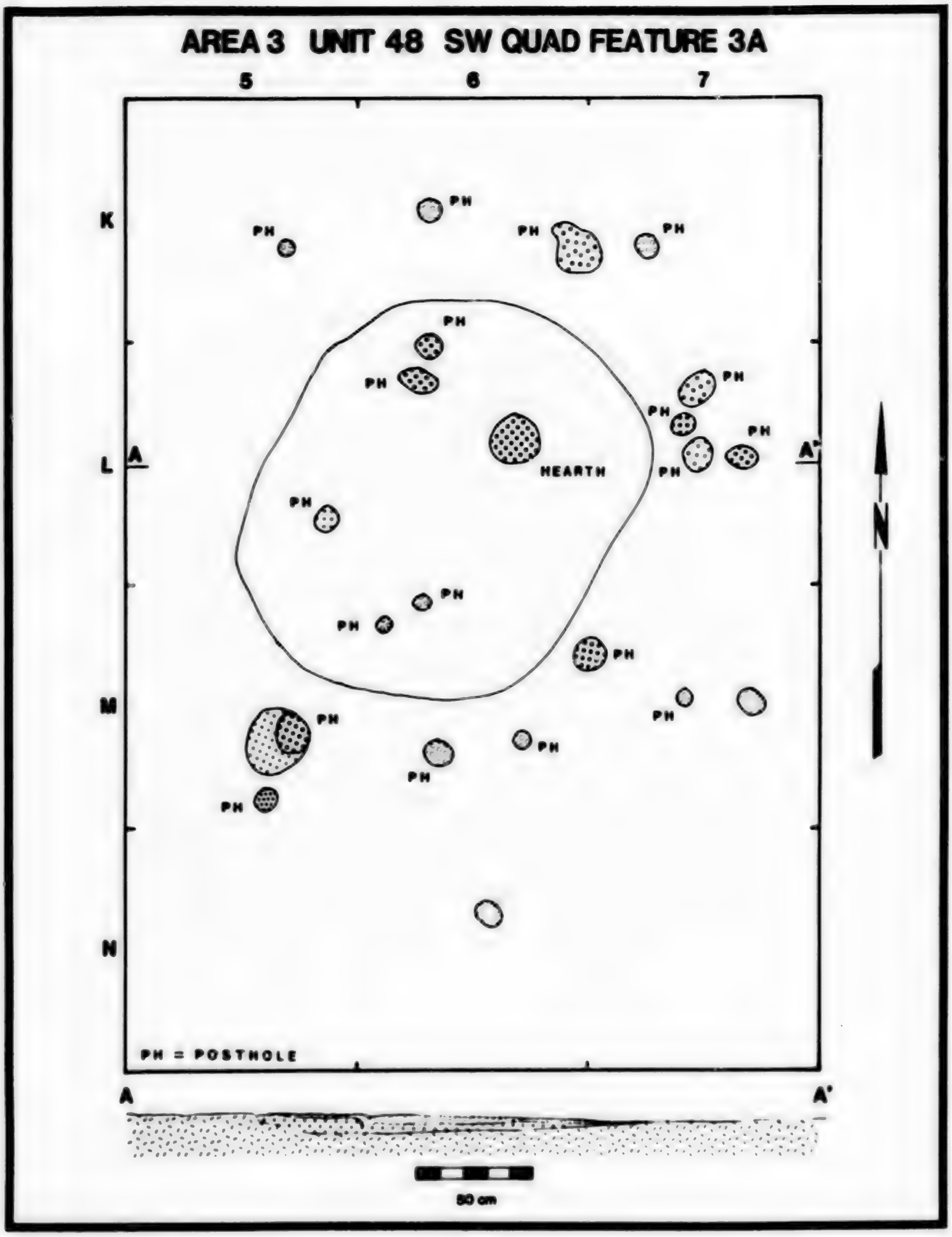


FIGURE 9.11.
FEATURE 3A IN UNIT 48SW.

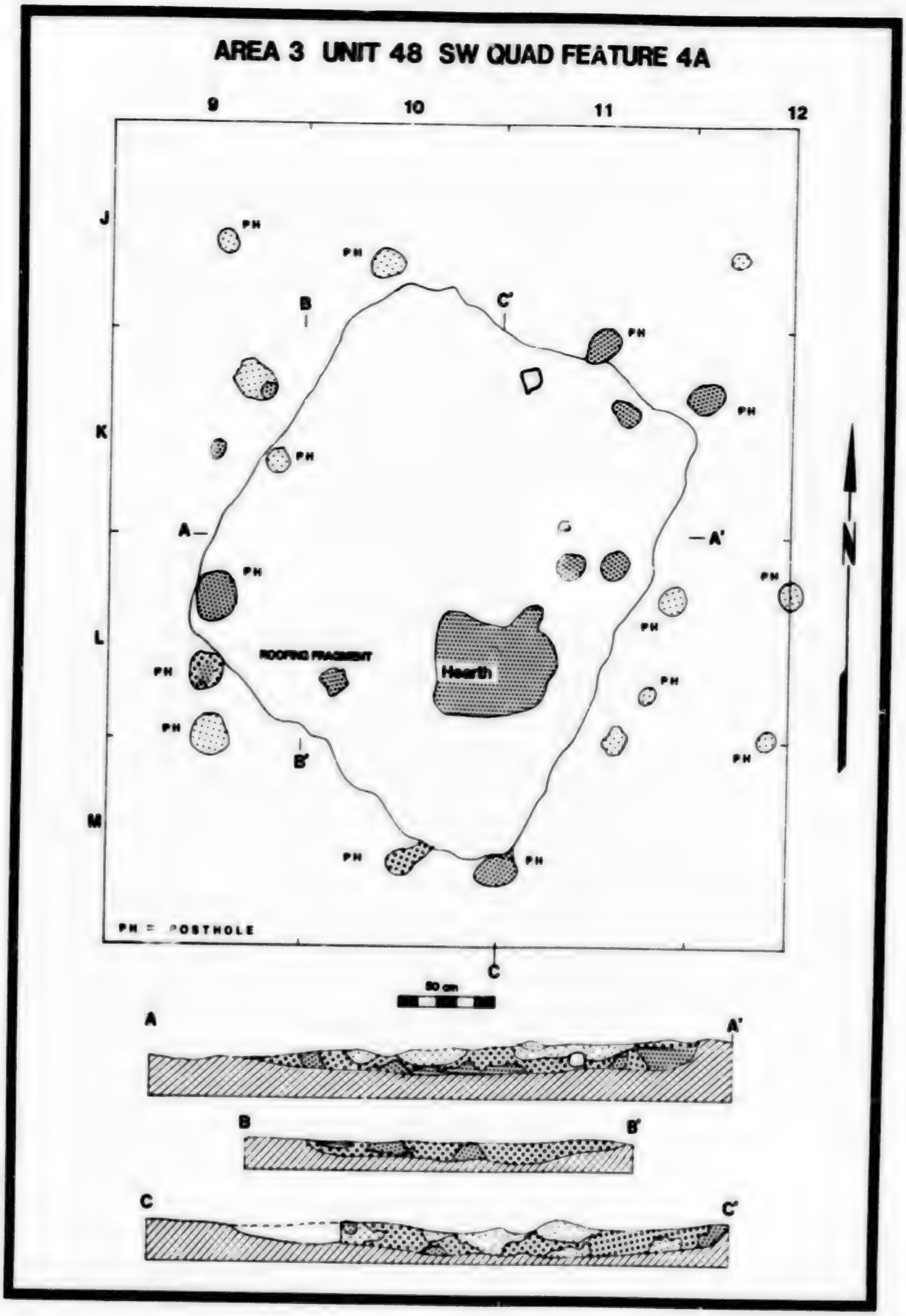


FIGURE 9.12.
FEATURE 4A IN UNIT 48SW.

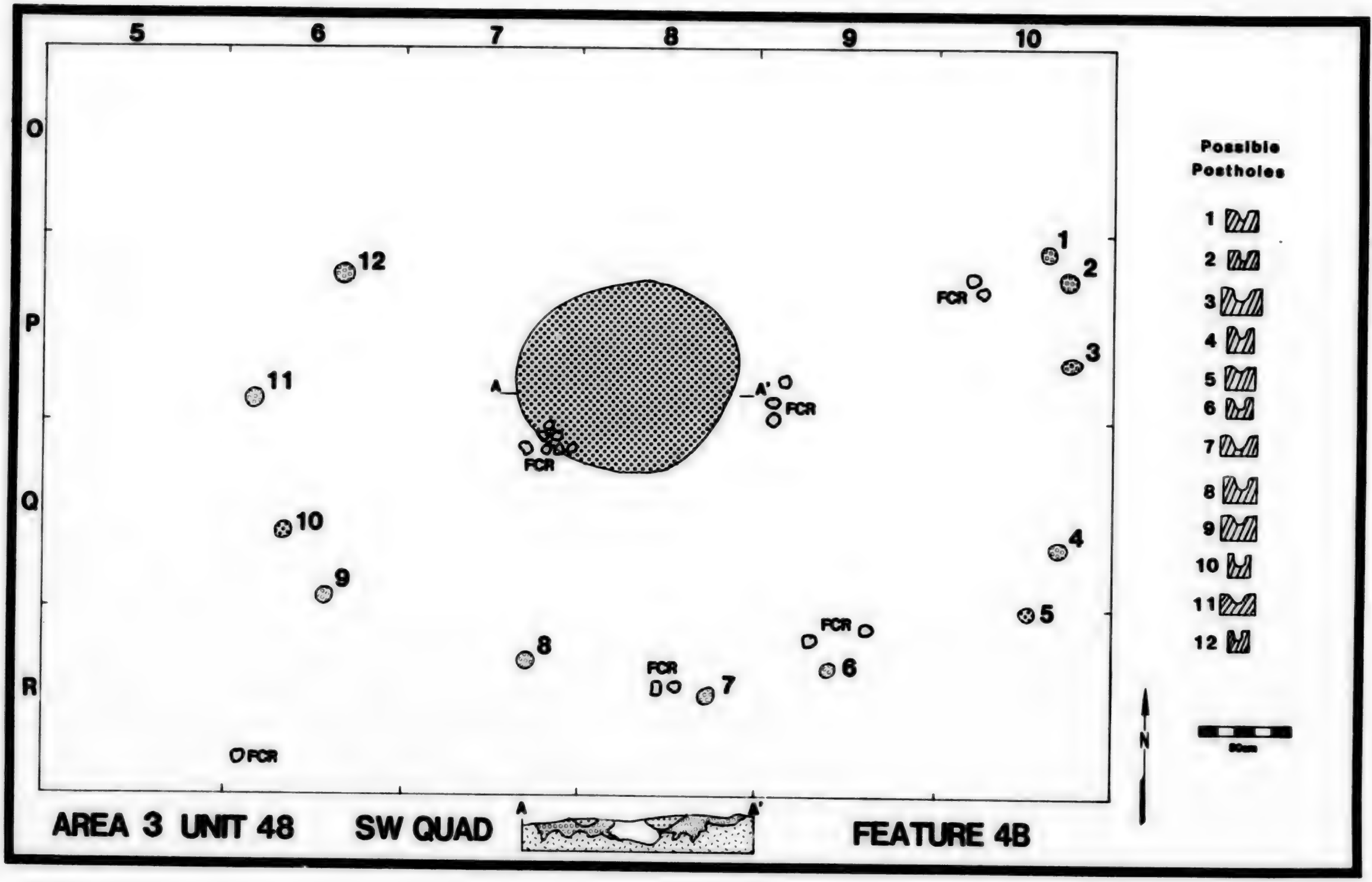


FIGURE 9.13.
FEATURE 4B IN UNIT 48SW.

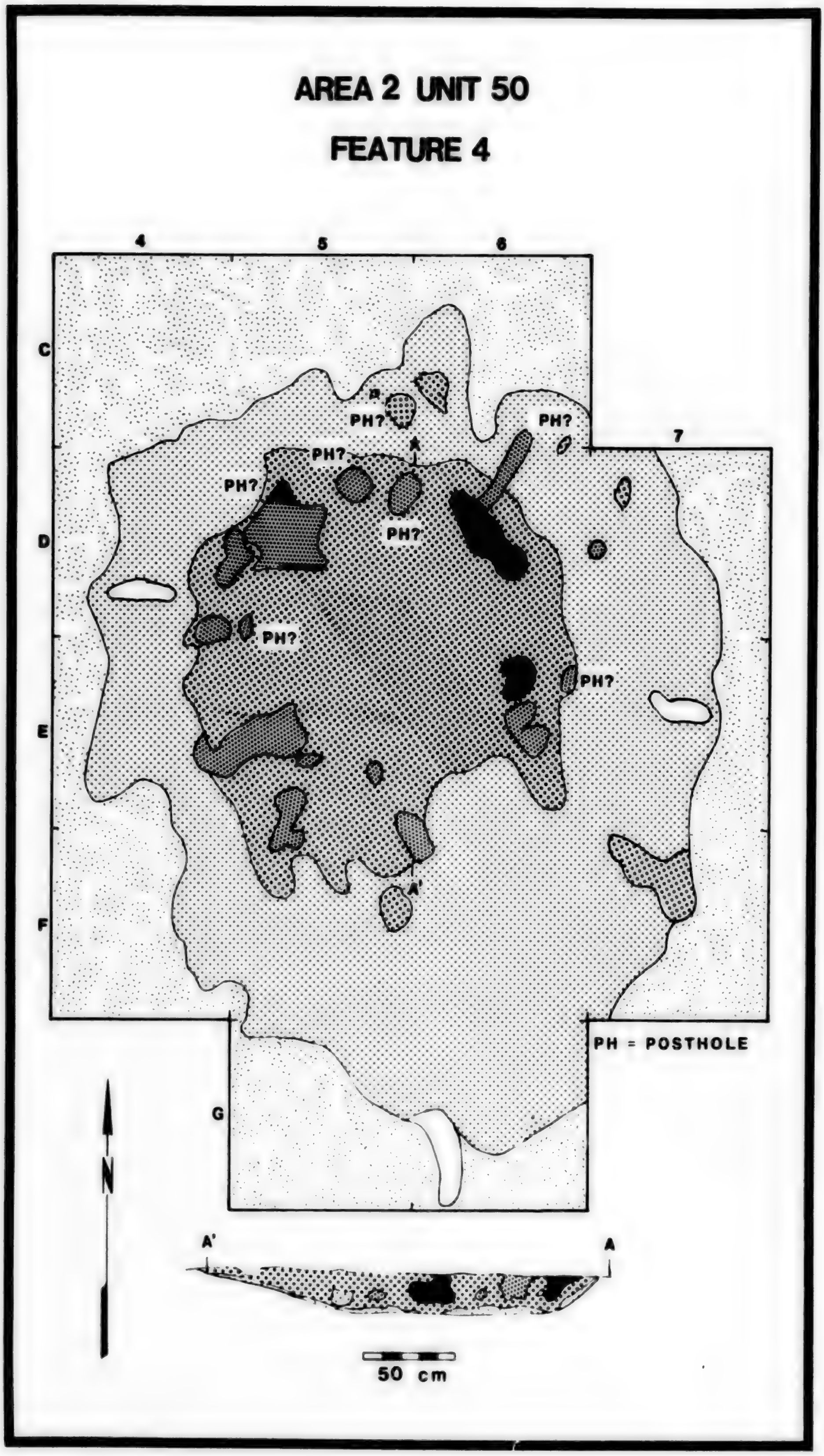


FIGURE 9.14.
FEATURE 4 IN UNIT 50.

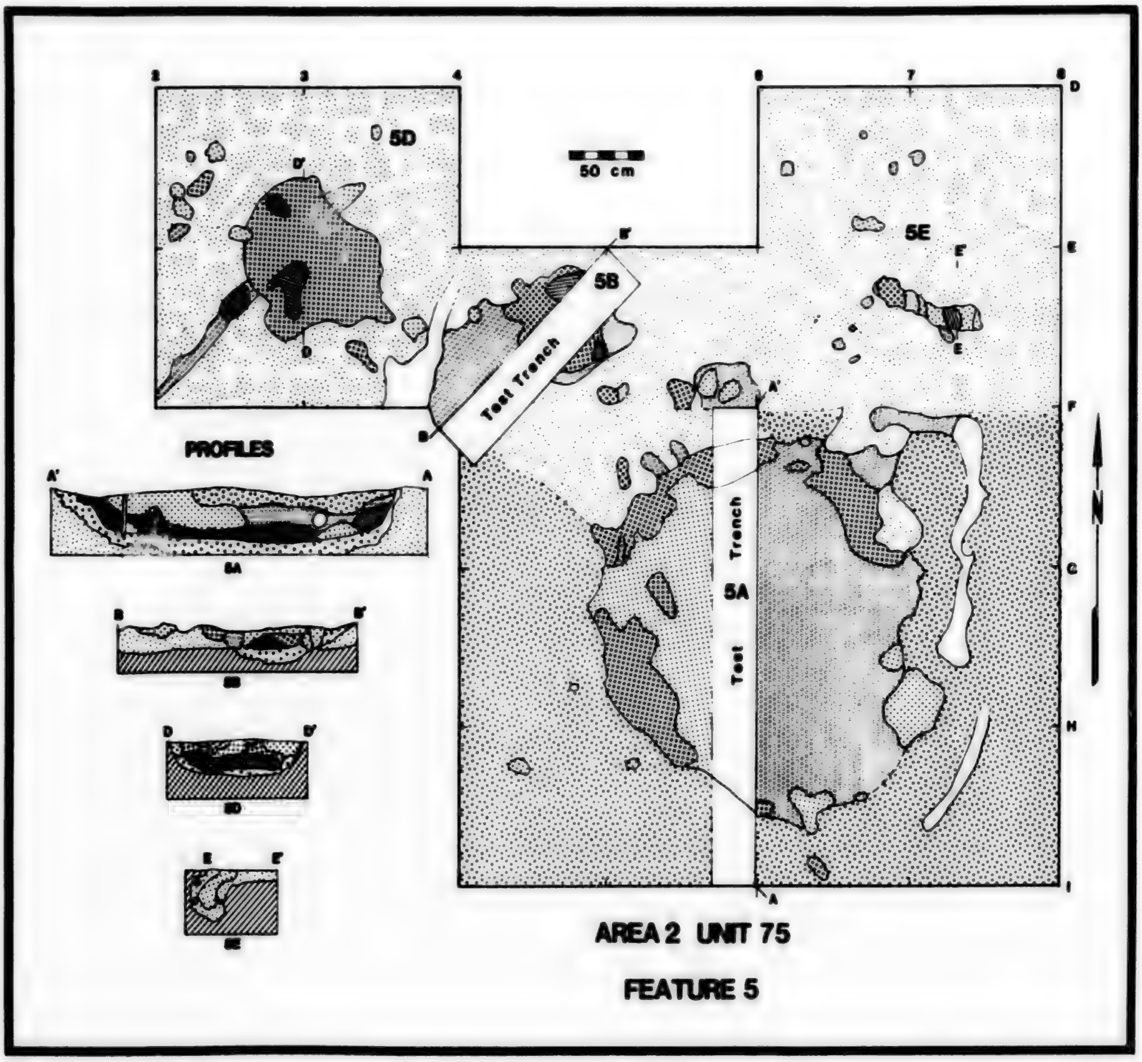


FIGURE 9.15.
FEATURE 5 IN UNIT 75.

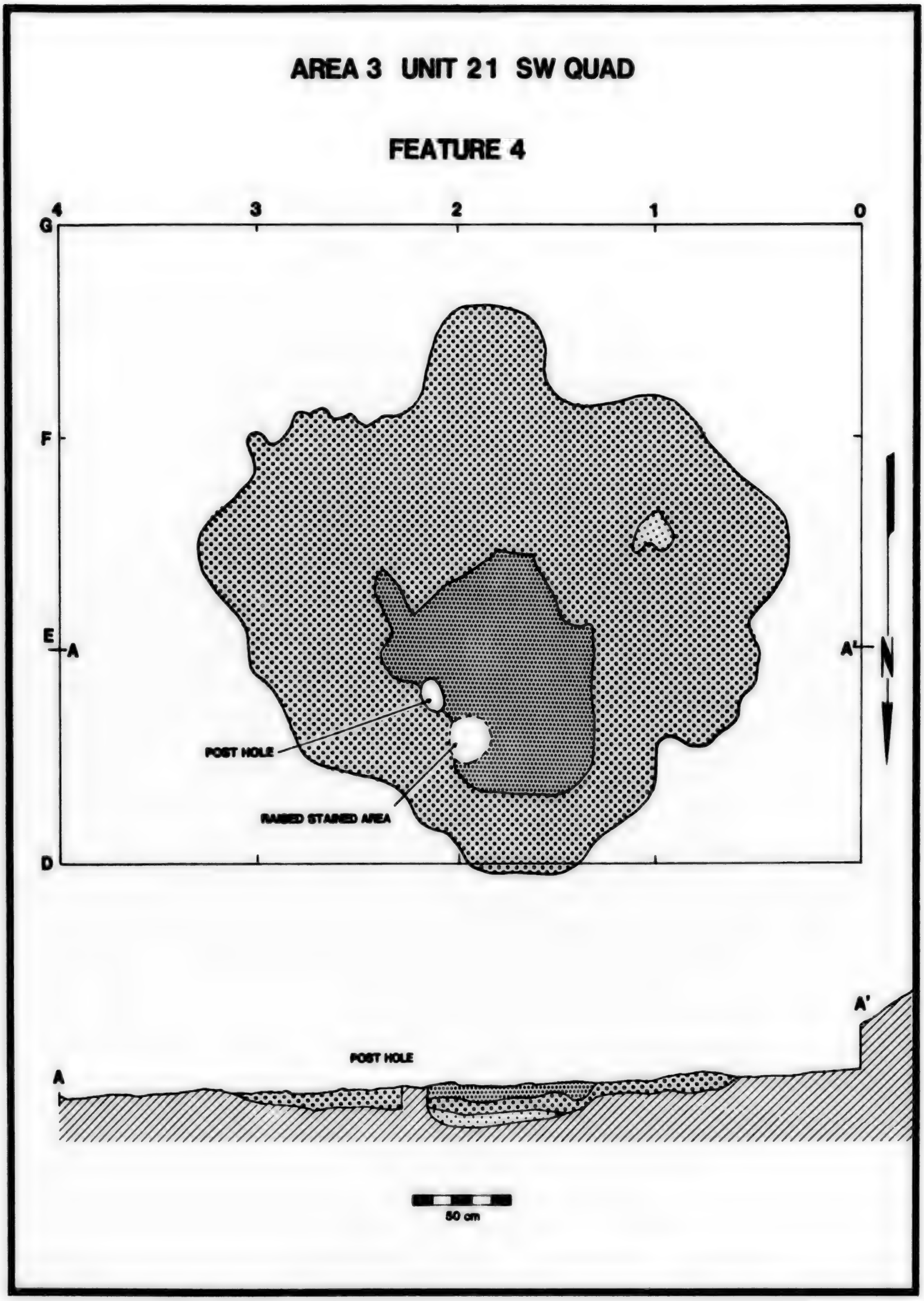


FIGURE 9.16.

ATURE 4 IN UNIT 21SW.

BLANK

PAGE

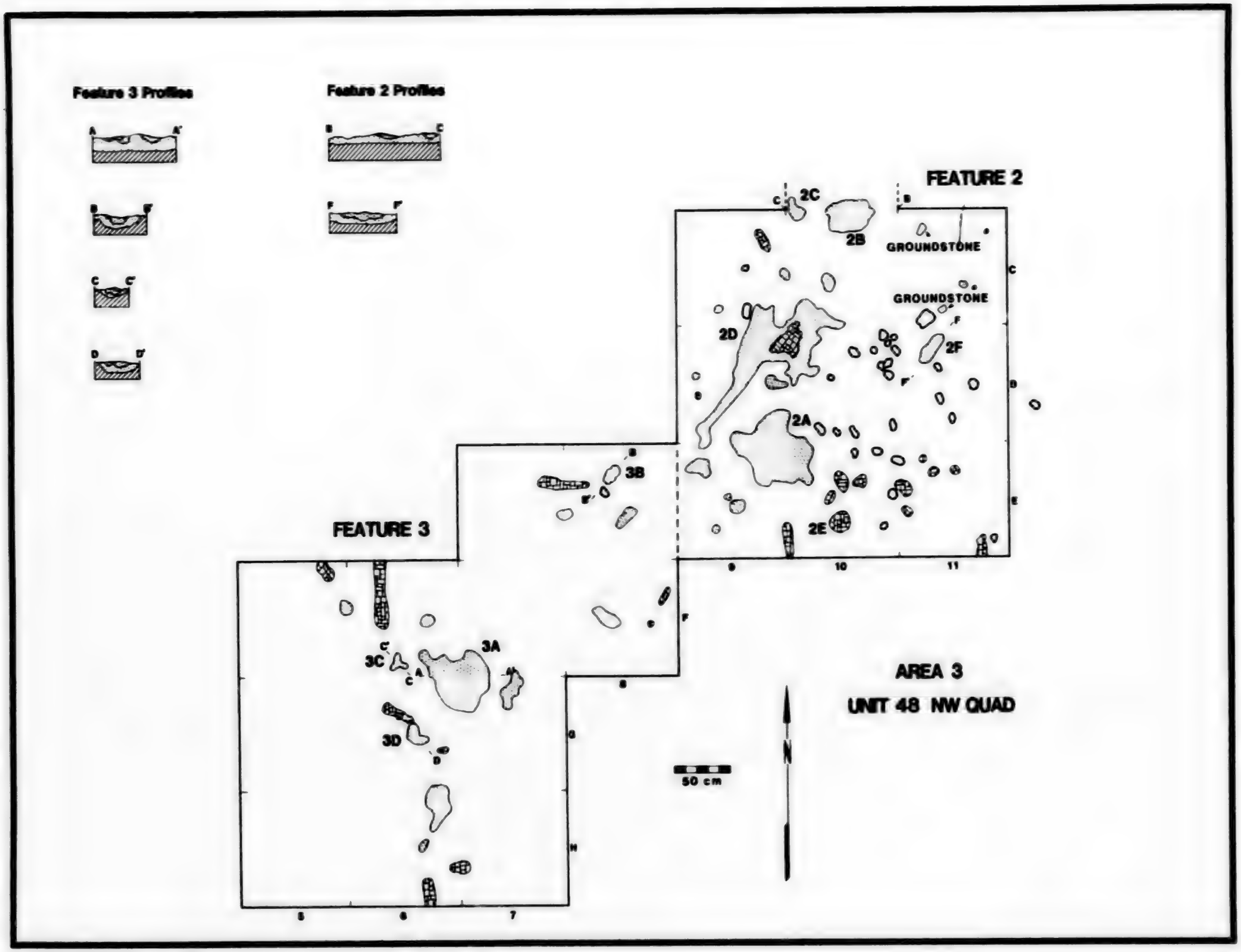


FIGURE 9.17. FEATURES 2 AND 3 IN UNIT 48NW.

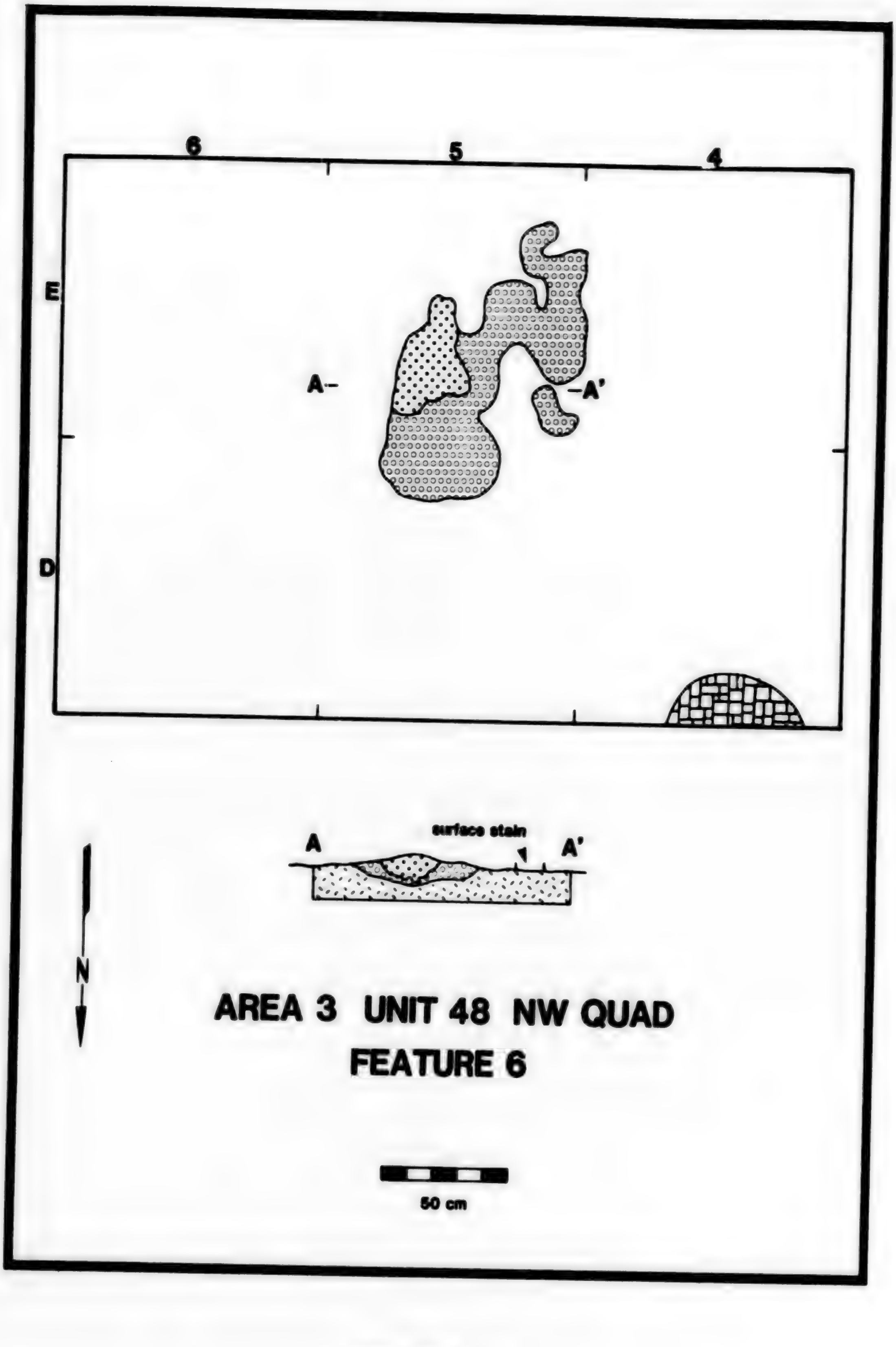


FIGURE 9.18.
FEATURE 6 IN UNIT 48NW.

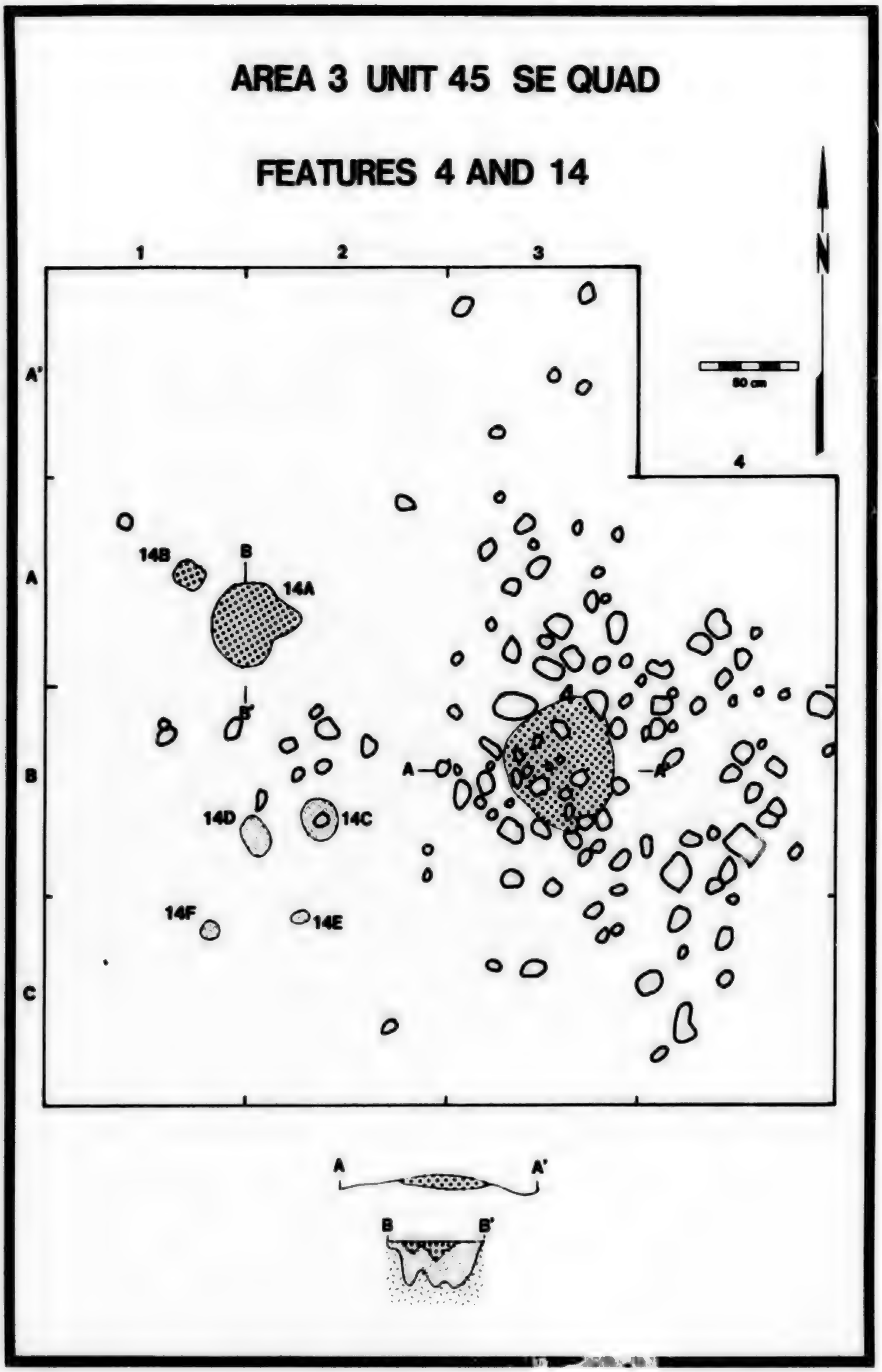


FIGURE 9.19.

FEATURES 4 AND 14 IN UNIT 45SE.

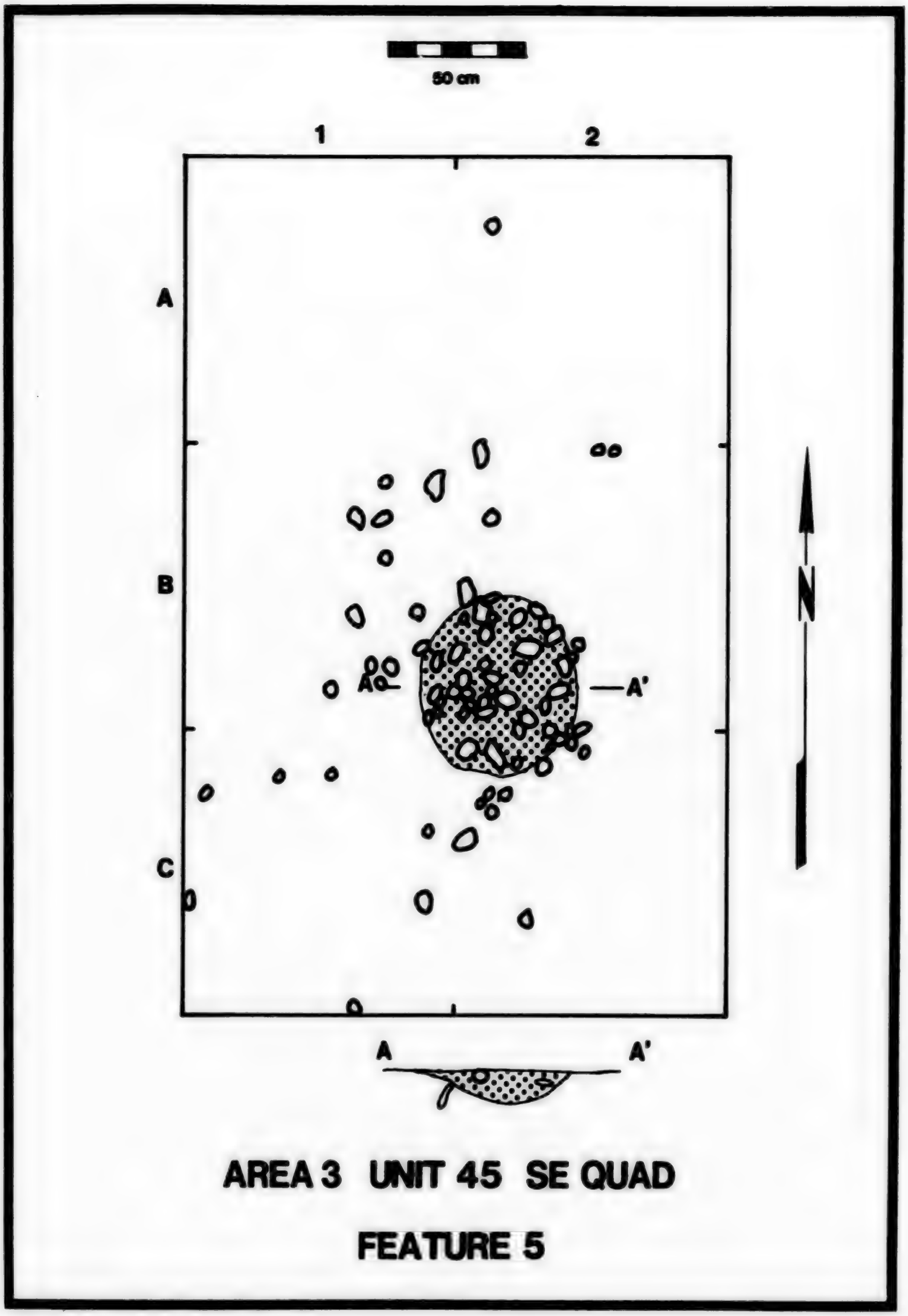


FIGURE 9.20.
FEATURE 5 IN UNIT 45SE.

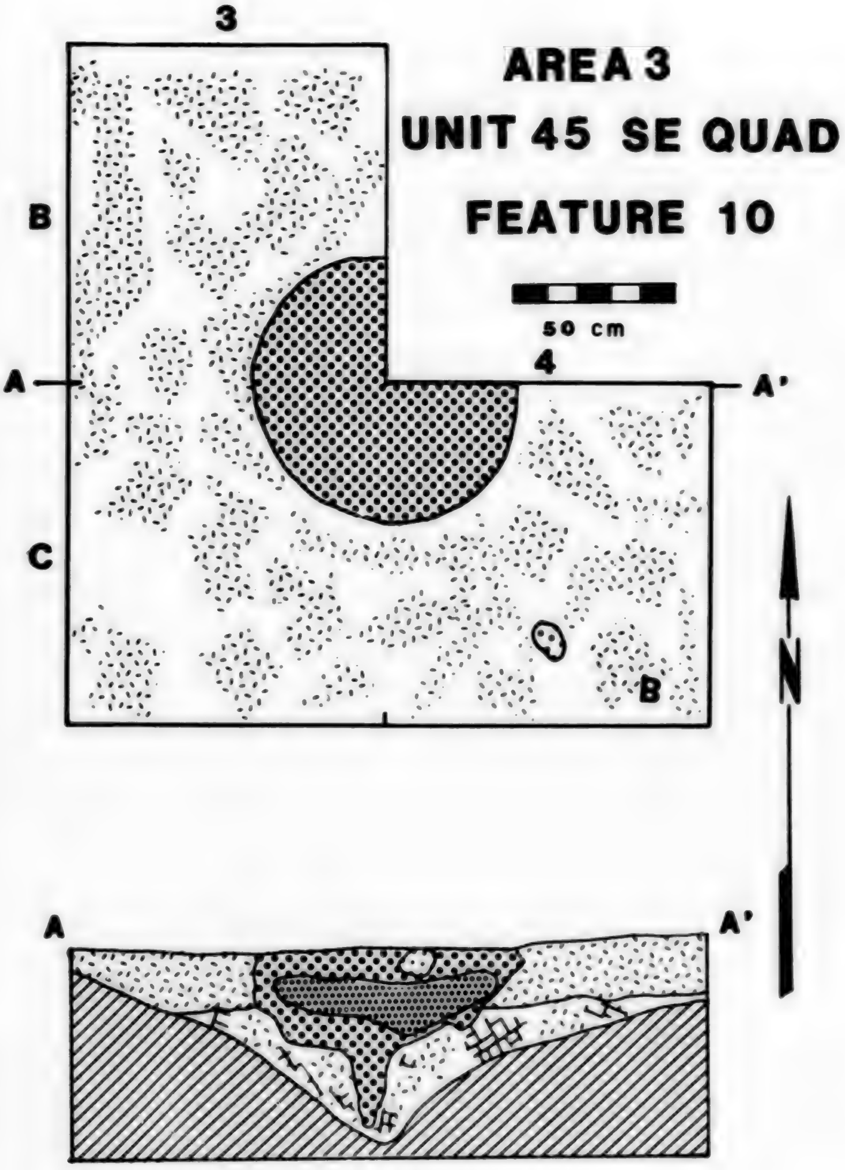


FIGURE 9.21.

FEATURE 10 IN UNIT 45SE.

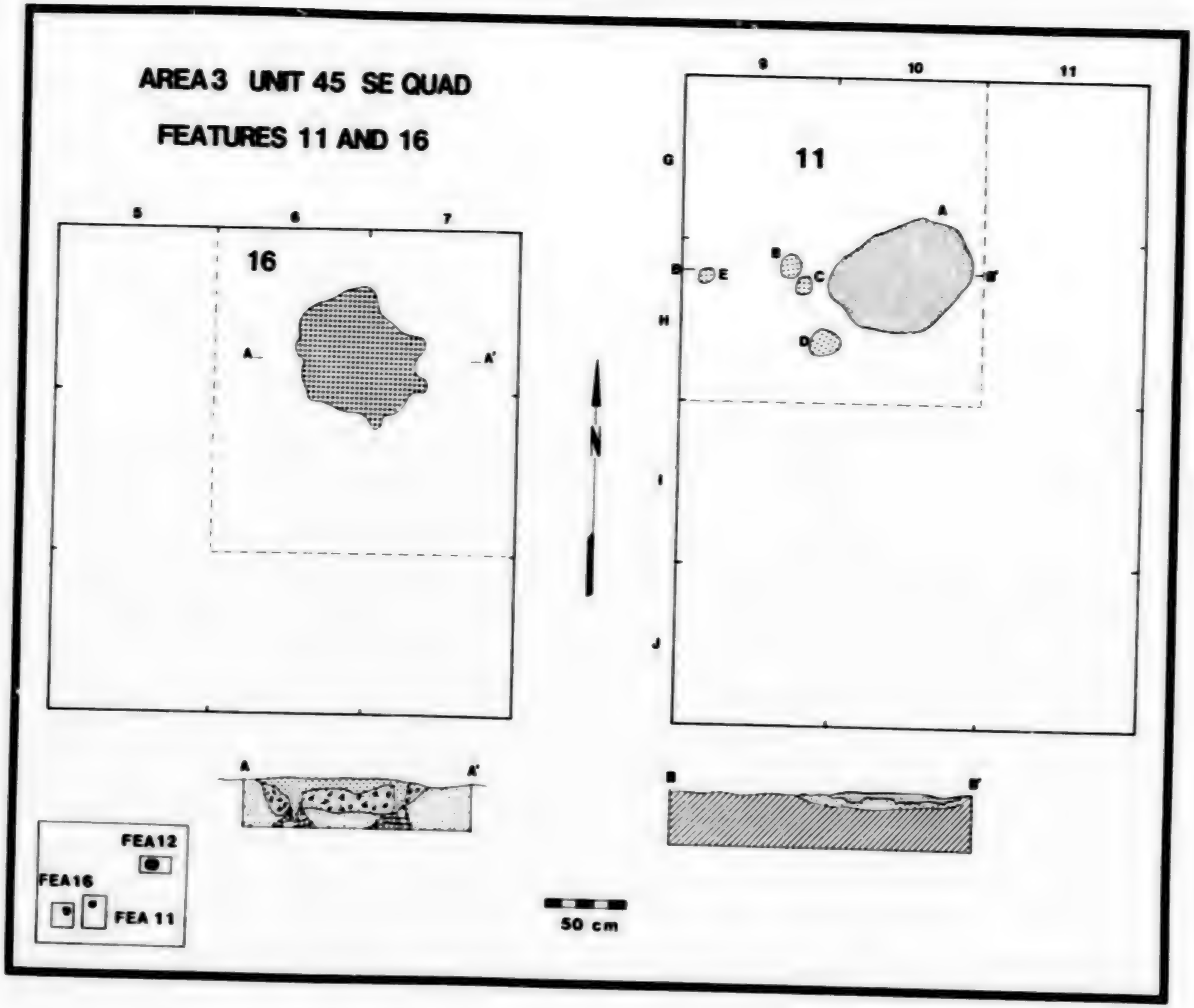


FIGURE 9.22.
FEATURES 11 AND 16 IN UNIT 45SE.

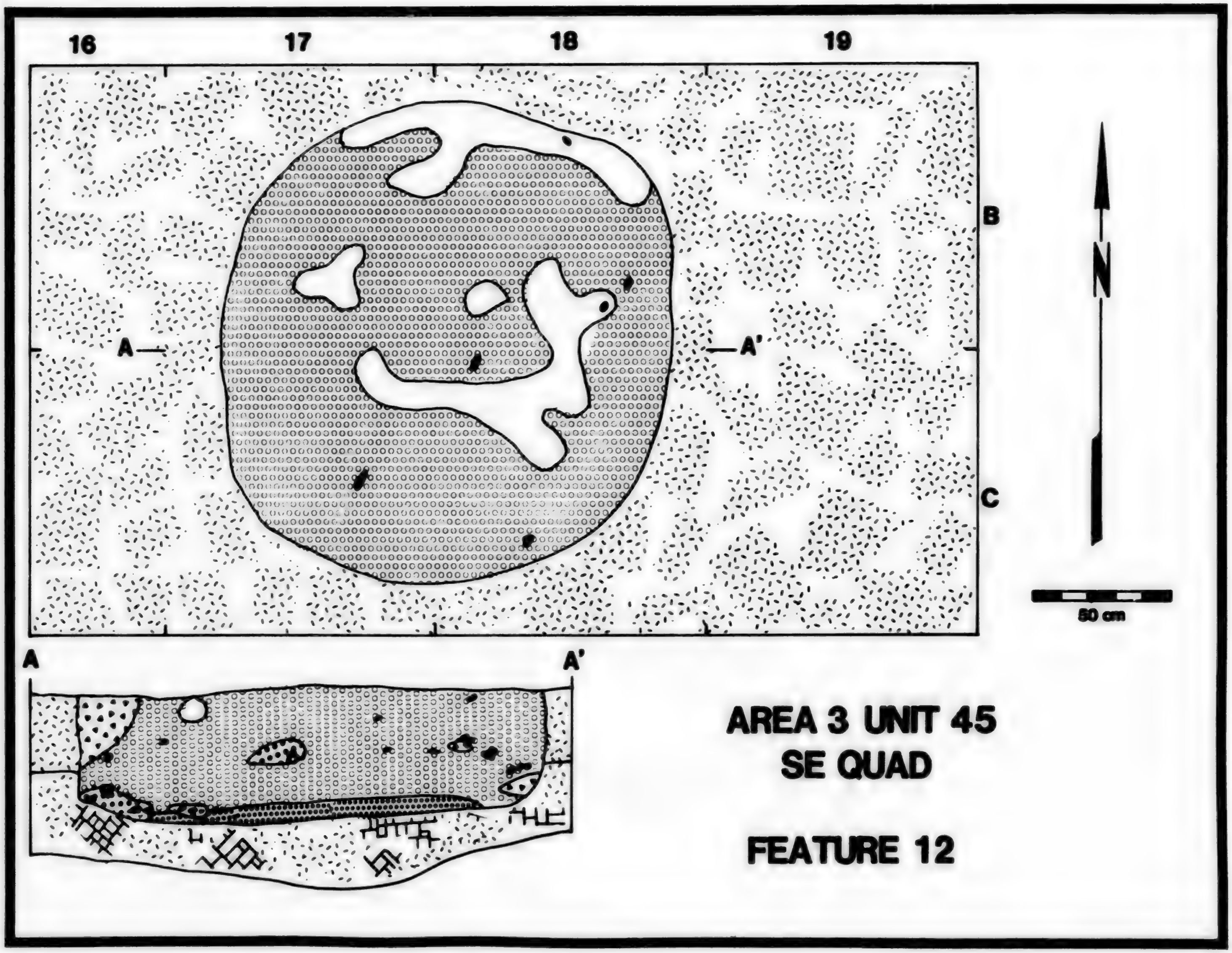


FIGURE 9.23.
FEATURE 12 IN UNIT 45SE.

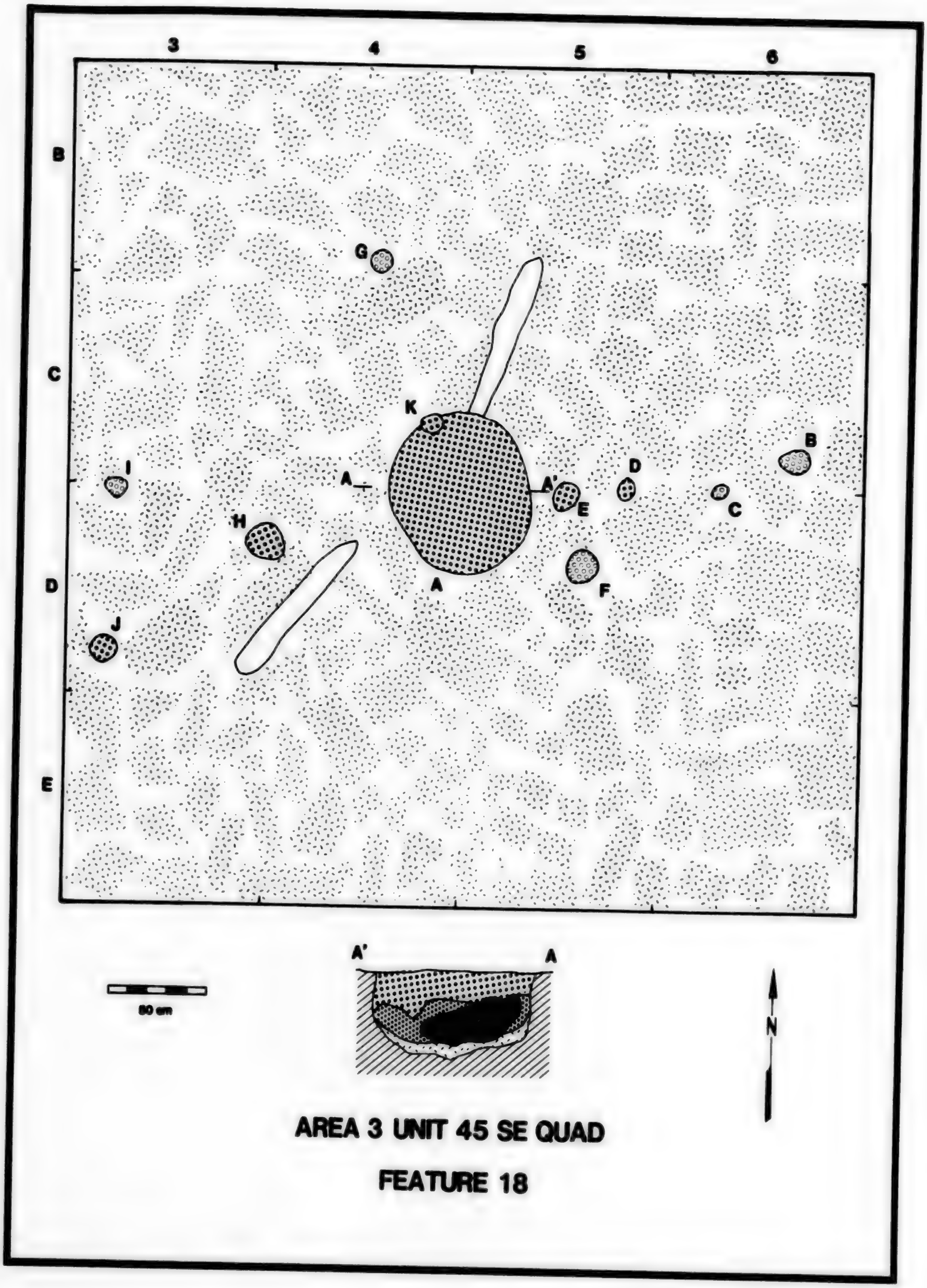


FIGURE 9.24.
FEATURE 18 IN UNIT 45SE.

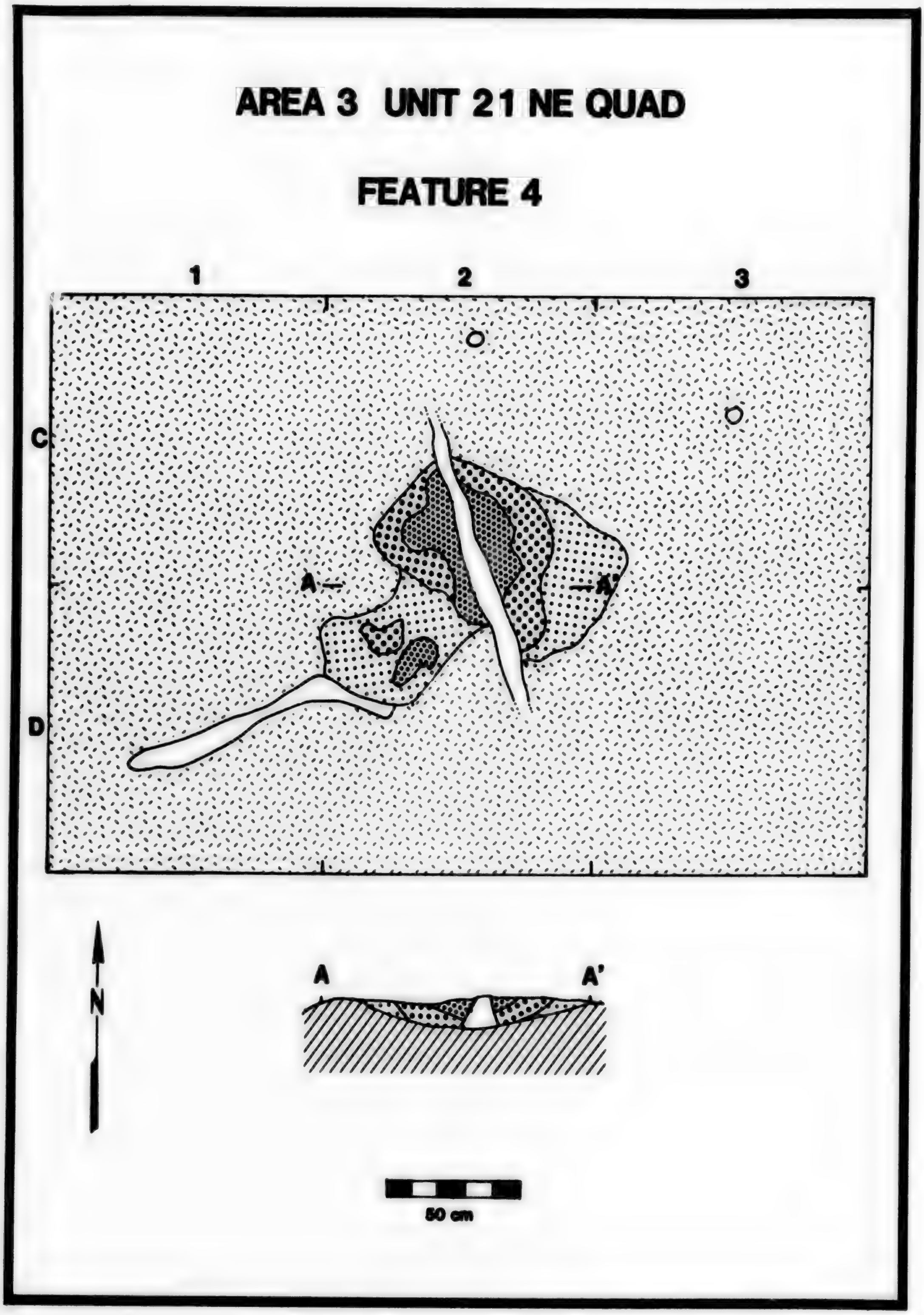


FIGURE 9.25.
FEATURE 4 IN UNIT 21SNE.

Table 9.1. Radiocarbon dates obtained for excavated features.

UNIT	FEATURE	SAMPLE	RADIOCARBON DATE YEARS B.P.	CORRECTED B.C./A.D. DATE	CONTEXT
45SE	2D	E92	3830 ± 90	2310 ± 320 B.C.	PIT STRUCTURE lower fill
	2D	E95*	4360 ± 100	3115 ± 255 B.C.	fill
	2D	E94	3950 ± 90	2490 ± 310 B.C.	lower fill
	2C	E91	2120 ± 90	220 ± 180 B.C.	PIT lower fill
	10A	E159*	2780 ± 80	1015 ± 230 B.C.	PIT lower fill
	12	E184	1870 ± 70	A.D. 115 ± 120	PIT lower fill
	12	E189	1790 ± 60	A.D. 210 ± 170	upper & lower fill
	13A	E146**	2950 ± 90	1150 ± 270 B.C.	PIT STRUCTURE
	18	E315	1680 ± 90	A.D. 325 ± 260	PIT, lower fill
	18	E332	1820 ± 70	180 ± 150 A.D.	lower fill
45SW	3	E116*	3530 ± 100	1920 ± 250 B.C.	PIT STRUCTURE fill
48NW	5A	E381	1670 ± 80	A.D. 325 ± 260	PIT STRUCTURE
48SW	1A	E618**	1500 ± 80	A.D. 430 ± 190	PIT STRUCTURE
	4A	E575**	1270 ± 120	A.D. 750 ± 160	PIT STRUCTURE floor
	4A	E546*	980 ± 70	A.D. 1060 ± 160	lower fill
	4A	E542***	1430 ± 100	A.D. 600 ± 180	fill
50	4	E632	2420 ± 100	530 ± 260 B.C.	PIT STRUCTURE lower fill
	4	E631	2690 ± 70	900 ± 130 B.C.	lower fill
75	5A	E704	2770 ± 70	950 ± 155 B.C.	PIT STRUCTURE lower fill
	5A	E705	2930 ± 70	1130± 230 B.C.	
	5B	E708	2880 ± 70	1065 ± 195 B.C.	Exterior hearth fill
	5D	E709	2780 ± 70	1010 ± 205 B.C.	Exterior hearth fill
21SW	4 Prov 1	E673**	1170 ± 110	A.D. 830 ± 200	PIT STRUCTURE lower fill
	4 Prov 1	E674	1000 ± 60	A.D. 1045 ± 150	lower fill
	4 Prov 1	E677	1030 ± 60	A.D. 1020 ± 135	lower fill
	4 Prov 2	E676*	1010 ± 90	A.D. 1050 + 180	Exterior pit (Prov 2)

NOTES: *Small samples 1 gram
**Very small samples 0.3 gram
***Samples E542,E543,E544,E563,E574

343

An additional early pit structure, Feature 3 in Unit 45SW, has a single corrected date of 1920 ± 250 B.C. Feature 13A, another possible pit structure in Unit 45SE located 4.2 meters to the northeast of Feature 3, is dated at 1150 ± 270 B.C. The contemporaneity of these features is not clearly determinable from these dates and does not necessarily follow their proximity to one another. Multiple dates for pit structures Unit 50 - Feature 4 and Unit 75 - Feature 5 overlap each other and place the occupations of these structures in or close to the first millennium B.C. The dates for two exterior hearths at Feature 5 in Unit 75 are consistent with those obtained for the pit structure itself suggesting the contemporaneity of these features.

Dates associated with ceramics include those from four pit structures. Two sherds of a fine-tempered polished brownware were the only artifacts recovered from Feature 4 in Unit 21SW for which the most recent date is A.D. 1050 ± 180. The most recent of three dates for Feature 4A in Unit 48SW, A.D. 1060 ± 160, is separated by at least 280 years from that of an adjacent structure, Feature 1A dated at A.D. 430 ± 190. Ceramics are abundant at the complex of features in Unit 48SW that includes Features 1A and 4A. Unspecific El Paso Brownware makes up a majority of the assemblage but jar sherds of El Paso Polychrome and El Paso Bichrome, representing two separate vessels, and fine-tempered polished brownware jar sherds representing at least one vessel are present in the assemblage. A single sherd of an unidentifiable type of Mimbres Whiteware was also recovered during excavation.

Unspecific El Paso Brownware is present at Feature 5A, a possible pit structure dating to A.D. 325 ± 260. Only four sherds of this type were recovered from the excavation, but 61 sherds of the same type are included in the surface inventory of artifacts from a 10 x 10 meter area surrounding the feature. This dated association of a possible pit structure and ceramics may be earlier than the ceramic-associated radiocarbon date of A.D. 250 ± 110 obtained by Whalen (1980:29) for small camps in the Hueco Bolson.

Dated hearths and pits in Unit 45SE range in age from 1015 ± 230 B.C. to A.D. 325 + 260. These features are clustered on an elevated ridge along with numerous pit structures and pits (see feature inventory in Chapter 4 and description of Unit 45SE features in following sections).

OBSIDIAN HYDRATION DATING

The following description of analytical procedures and results was provided by Christopher M. Stevenson of the Obsidian Hydration Dating Laboratory at New Mexico State University (NMSU). The hydration rate used to calculate absolute dates has resulted in a wide variation in hydration rim measurements on obsidian from early contexts. According to Stevenson (personal communication), the absolute dates obtained for obsidian artifacts recovered at excavated features are therefore based on a hydration rate formula that has provided questionable results. Since temperature and relative humidity effect the hydration rate of obsidian (Friedman and Smith 1960; Michaels 1973) differences in the amount of time artifacts lie exposed on the ground surface and the depth of sediments overlying buried obsidian artifacts will cause the hydration rate to vary for artifacts produced at the same time but from differing post-depositional contexts. In the coppice dune environments of desert basins, the continuously shifting position of sand dunes ensures that relative temperature and humidity differences affecting an obsidian hydration rate will occur over very short distances.

Presently, a radiocarbon calibrated hydration rate is being constructed for Rio Grande Group II obsidian (Robert Hard and Christopher Stevenson, personal communication) that may provide a more accurate estimate of the dates of use for obsidian artifacts of this material, but it will still be confronted with the problem of controlling for variation in the length of surface exposure and buried context of artifacts. Perhaps even more of a concern is the fact that artifacts spatially associated with features yielding radiocarbon dates may have not been used while the feature itself was in use. The absolute dates offered in Table 9.2 must therefore be considered in light of these problems. Following the discussion of procedures presented immediately below, hydration band widths are compared among features and with radiocarbon determinations.

Table 9.2. Obsidian Hydration Dates For Quadrant 45SE.

Lab No.	Provenience	Width	S.D.	Group	Date	S.D.
86-1	Gr. 9-4C,F.3,7,15	-- Too Diffuse --		OR	-	-
86-2	Gr. 9-5H,F.3,7,15	10.27	0.03	OR	3794 BC	285
86-3	Gr. 9-10B,F.3,7,15	5.86	0.04	OR	103 AD	183
86-4	#179,F.3,7,15	5.40	0.03	OR	387 AD	151
86-5	#181,F.3,7,15	5.55	0.05	OR	297 AD	155
86-6	#2008,F.3,7,15	4.29	0.05	OR	976 AD	120
86-7	#2079,F.3,7,15	5.27	0.05	OR	463 AD	148
					321 AD	154
86-8	#2081,F.3,7,15	10.90	0.06	OR	4525 BC	302
86-9	#2080,F.3,7,15	6.56	0.06	OR	373 BC	183
86-10	#2153,F.3,7,15	9.15	0.04	OR	2603 BC	254
86-11	Sq. 2C,F.3,7,15	6.51	0.02	OR	337 BC	182
86-12	Sq. 4B,F.3,7,15	— Too Diffuse —		OR	-	-
86-13	Sq. 5A,F.3,7,15	4.87	0.04	OR	685 AD	137
86-14	Sq. 12C,F.3,7,15	5.00	0.03	OR	615 AD	140
86-15	Sq. 9H,F.11,16	-- Too Diffuse --		GR	-	-
86-16	Sq.. 10G,F.11,16	6.02	0.04	GR	-	-
86-17	Gr. 5-6G,F.11,16	10.27	0.07	OR	3794 BC	285
		8.72	0.05		2182 BC	242
86-18	Gr. 5-6J,F.11,16	5.42	0.05	OR	375 AD	152
8-19	Gr. 5-7G,F.11,16	2.93	0.04	GR	-	-
86-20	Gr. 5-8I,F.11,16	4.17	0.05	OR	1032 AD	118
86.21	Gr. 5-10H,F.11,16	4.76	0.03	OR	743 AD	133
86-22	Gr. 5-11E,F.11,16	-- Too Diffuse --		GR	-	-
86-23	Gr. 5-13K,F.11,16	2.72	0.02	GR	-	-
86-24	Gr. 5-14J,F.11,16	6.50	0.06	OR	121 BC	174
86-25	#3593,F.11,16	3.04	0.04	GR	-	-
86-26	Gr. 5-8I,F.11,16	3.98	0.02	OR	1117 AD	113
86-27	Sq. 19B,F.12	4.34	0.05	?	-	-
86-28	Gr. 5-17F,F.12	5.27	0.04	OR	463 AD	148
86-29	Gr. 5-18D,F.12	3.63	0.04	GR	-	-
86-30	Gr. 5-20F,F.12	31.00	-	PO	-	-
86-31	Gr. 5-21G,F.12	5.10	0.03	OR	560 AD	143
86-32	Gr. 9-2G,F.8,9,17	6.04	0.03	OR	14 BC	169
86-33	Gr. 10-4C,F.8,9,17	4.59	0.02	OR	830 AD	129
86-34	Gr. 10-6A,F.8,9,17	3.03	0.05	GR	-	-
86-35	#338,F.8,9,17	5.07	0.03	OR	576 AD	142
86-36	#2281,F.8,9,17	5.97	0.03	OR	32 AD	167
		11.30	0.02		5012 BC	313
86-37	#2948,F.8,9,17	5.77	0.04	OR	161 AD	162
		3.21	0.02		1420 AD	91
86-38	#3508,F.8,9,17	4.25	0.03	OR	995 AD	120
		3.63	0.03		1263 AD	103
86-39	#3529,F.8,9,17	10.53	0.06	OR	4091 BC	292
86-40	Sq. 2C,F.8,9,17	4.03	0.02	OR	1095 AD	114
86-41	#2302,F.5	6.89	0.03	?	-	-
86-43	#632,F.3,4,13	9.84	0.04	OR	3321 BC	273
86-44	Gr. 1-9H,F.3,4,13	3.43	0.06	GR	-	-
86-45	Gr. 1-5F,F.3,4,13	7.06	0.04	OR	746 BC	197
86-46	Sq. 10A, Surface	5.39	0.05	OR	393 AD	151
86-47	Sq. 8A, Surface	5.74	0.04	OR	180 AD	162
86-48	#561	-- Too Diffuse --		OR	-	-
86-49	#1963	6.08	0.03	OR	40 BC	171
86-50	#2919	-- Too Diffuse --		OR	-	-

NOTES: OR = Obsidian Ridge, GR = East Grants Ridge, POL = Polvadera Peak,
? = Unknown Obsidian Source

ANALYTICAL PROCEDURES AND RESULTS

Forty-nine archaeological obsidian specimens were submitted to the NMSU Obsidian Hydration Dating Laboratory for analysis. Forty-three of the specimens had readable hydration bands. Hydration rims on six artifacts could not be reliably measured, and one item was not a natural glass. Chronometric dates have been estimated for each of the artifacts identified by XRF analysis as originating from the Obsidian Ridge source.

In southern New Mexico, obsidian raw material occurs as sparse subrounded clasts in the Pliocene and Pleistocene gravels of the Rio Grande. These materials have been transported down river from primary obsidian sources located in the northern part of the state. Minor and trace element analysis by the NMSU Obsidian Dating Laboratory indicates that 14 distinct chemical types of obsidian occur within the gravel deposits. Solid sample X-ray fluorescence analysis of the Quad 45SE specimens indicates that four distinct chemical groups are present within the archaeological sample. Three of the obsidian types can be assigned to their parent source on the basis of their trace element concentrations:

Obsidian Ridge:	38
Polvadera Peak:	1
Grants Ridge:	9
Unknown:	2

Sample preparation and hydration rim measurement were conducted according to the guidelines presented in Michels and Bebrich (1971). Hydration bands were measured at 1000x with a Nikon Optiphot-Pol microscrope and video measurement system. Provenience data and hydration rim measurements are presented on Table 9-2. The standard deviation associated with each rim measurement reflects the precision error associated with the measurement process. The standard deviation associated with each date has been calculated using an error factor or 0.25 um; the limits of resolution associated with the optical microscope.

The hydration bands on six of the artifacts could not be accurately measured due to an inability to clearly identify the diffusion front boundary. These slides were re-prepared in order to improve the optical quality of the thin-section but without success.

Hydration rate constants for the Obsidian Ridge source have been derived using a modified version of the experimental procedures developed by Michels et al. (1983). Freshly fractured obsidian flakes are hydrated in a solution of deionized water and amorphous silica at temperatures ranging from 110°C to 170°C for periods of 4 to 12 days. The hydration rate constants (pre-exponential and activation energy) are derived from a statistical analysis of the induced hydration rims. For the Obsidian Ridge source, this has resulted in an activation energy of 79202 Joules/mole and a pre-exponential value of 2.01 at 160°C.

The effective hydration temperature and hydration rate for artifacts from Quad 45SE were calculated for a depth of 30 centimeters using a soil temperature estimation model. The imput parameters for the model are the published values for Las Cruces, New Mexico presented by Farrer et al. (1983):

Mean annual earth temp.:	62°F
Temperature amplitude:	19
Phase Constant:	20
Thermal diffusivity:	0.35

This resulted in a hydration rate of 18.25 um^2/1000 years which was used to calculate the absolute dates presented on Table 9-2. Hydration rate constants are not available for the other obsidian types present within the assemblage.

Correspondences Between Radiocarbon and Hydration Band Widths

Hydration rim measurements can be compared among samples from single features and complexes of features. Obsidian artifacts from features in seven spatial clusters or associations of artifacts (see Chapter 4 for a description of the derivation of spatial associations) were submitted for source analysis and hydration rim measurement. Table 9.3 lists the areas of artifact clusters from which obsidian was collected, the features contained within this area, obsidian hydration band widths, and any associated radiocarbon dates. Only those samples assigned to the Obsidian Ridge source are included in the table.

Table 9.3. Obsidian hydration measurement and radiocarbon date comparisons for Obsidian Ridge source gravels.

Unit Cluster	Area (m2)	Feature Nos.	Hydration Bank Width (microns)			Corrected BC/AD Dates
			mean	s.d.	n	
25	28.12	3,7,15	6.55	2.15	13	-
12	17.92	11,16	6.20	2.40	6	-
101	19.71	12	5.19	0.12	2	A.D. 115 A.D. 210
3	50.47	8,9,17	5.97	2.96	11	-
8	23.00	5	6.89	-	1	-
26	31.02	3,4,13	8.45	1.95	2	1920 B.C. Feature 3
24	1.85	2	5.57	.25	2	220 B.C. Feature 2C 2310 B.C. Feature 2D

Features yielding sufficient charcoal for radiocarbon dating were not always associated with obsidian artifacts. There are, however, three sets of features for which both radiocarbon dates and obsidian hydration rim measurements were obtained. Increased hydration rim width is correlated with earlier radiocarbon dates for Features 12, 2C, and 13 in Unit 45 but this correlation is not without potential inconsistencies. The complex of features in Cluster 24 contains Feature 2C as well as an earlier dated pit structure, Feature 2D. Obsidian samples from this cluster are within the vicinity of both features but are located several meters nearer to Feature 2C. It is not possible to determine with which feature the obsidian artifacts are associated, if they were used during the same occupation as the features at all.

With the few numbers of radiocarbon and obsidian dated samples here, a consistent trend in decreasing rim width through time is questionable, but would indicate that other features in survey Unit 45 from which obsidian samples were obtained were constructed sometime between 1150 B.C. and A.D. 200. Another interpretation of this pattern, however, may be that a relatively similar exposure period obtains for obsidian associated with features in Unit 45 due to similarities in exposure and elevation of features. All undated features are situated on a main north-south trending ridge in Unit 45SE (see Figure 8.13) where they are exposed on the open ridgetop and to the west-southwest. Expansive interdunal surfaces and high-relief dunes in this location indicate relatively rapid shifts in dune position and over the long-term most places on this surface might lie buried and exposed for the same lengths of time. If this is the case, then hydration measurements on obsidian will not necessarily date the artifacts, but will indicate similarities and differences between the exposure period of artifacts.

MACROFLORAL AND FAUNAL REMAINS

Forty-four flotation samples of pit and pit structure fill were submitted to Thomas C. O'Laughlin for identification of macrofloral remains (Appendix G). A majority of these contained unburned seeds which are possible recent contaminants, while 17 samples contained burned seeds and 20 identifiable charcoal. Other macrofloral specimens were contained in an additional seven samples. Multiple flotation samples obtained from pit and pit structure fill yielded identifiable burned seeds, charcoal and other plant parts for 11 separate features. This section briefly summaries the results of the flotation analysis and compares macrofloral remains in samples with the pollen spectra identified in associated samples. Pollen samples were submitted to Linda J. Scott at Palynological Analysts; and, descriptions of pollen analysis techniques and specific results are contained in Appendix H.

Macrofloral remains are first considered in tabular form by feature (Table 9.4). Of the 11 features yielding identifiable remains, 5 are pit structures -- Unit 21SW-4, Unit 45SE-2D, Unit 48SW-4A and Unit 75-5 -- and one, Unit 48NW-5, has been interpreted as a possible pit structure. Several larger pits in Unit 45SE, Features 10A, 12, and 18, also yielded macrofloral remains.

Mesquite charcoal in pit structure samples could be interpreted as construction material, or as fuel in all but the case of the pit structure in Unit 75 which appears to lack an internal hearth feature. Wood charcoal is noticeably sparse in samples from pit structure 4A in Unit 48SW compared to the abundance of other materials in this sample. Grass stems, yucca stalks, and leaves in samples from this feature may have been used to construct a superstructure. Yucca leaves are also noted as having been used to manufacture sandals, basketry, nets, and matting (Castetter and Bell 1942).

Burned seeds from most pit structures and pits are too few for interpretations of their intentional use to be made with certainty and may be present in samples simply as the result of their natural presence among fuel materials. Some processing of *Portulaca* and *Amaranthus* may be indicated for pit features 12 and 18 in Unit 45SE. The pollen spectra for these features (Figure 9.26) includes high frequencies of Cheno-ams and high-spine composites in slightly higher abundance than that of the present ground surface which may also indicate seed processing. A yucca pod in the fill of Feature 18 may also indicate use of the fruits of this plant according to O'Laughlin (personal communication). *Helianthus* is in more than one sample from the Unit 48SW pit structure which

Table 9.4. Burned seeds, charcoal, and other plant parts from flotation samples.

FEATURE	CONTEXT	MACROFLORAL REMAINS
Unit 21SW		
Feature 4	internal pit	3 unidentified seed fragments
		1 Cheno-am seed
		1 *Sphaeralcea* (mallow?) seed
		10 pieces of *Prosopis* charcoal
	pit structure fill	2 pieces of *Prosopis* charcoal
Unit 45SE		
Feature 2C	pit fill (floor contact)	2 *Astragalus*? seeds
		1 piece *Atriplex*? charcoal
Feature 2D	pit structure fill	1 burned flower stalk or pod Liliaceae family
Feature 10A	pit fill	1 piece *Prosopis* charcoal
Feature 12	pit fill	5 *Portulaca* seeds
		1 unidentified seed fragment
		45+ pieces of *Prosopis* charcoal
Feature 18	pit fill	3 *Amaramthus* seed
		1 probable burned yucca pod
		65+ pieces of *Prosopis* charcoal
Unit 48NW		
Feature 3A	ash deposit	2 Gramineae seeds
		1 unidentifiable seed fragment
Feature 5A	pit structure	19 *Sporobulus* sp. seeds
		1 Gramineae seed
Feature 6	deflated pit/ hearth	2 *Sporobulus* sp. seeds
		1 Gramineae seed
Unit 48SW		
Feature 4A	pit structure fill	1 Chenopodiaceae seed
		1 *Helianthus* seed
		1 unidentifiable seed fragment
		84 *Sporobulus* sp. seeds
		23 grass stems
		11 pieces *Yucca elata* flower stalk
		1 pieces Prosopis charcoal
	pit structure floor	48 *Sporobulus* seeds
		19 Gramineae stems
		31 pieces of *Yucca* sp. leaves
	pit structure interior hearth	422 *Sporobulus* seeds
		1 *Helianthus* seed
		2 unidentifiable seed fragments
		56 Gramineae stems
		1 piece *Yucca* sp. flower stalk
		1 piece *Atriplex* charcoal
	exterior hearth	5 *Sporobulus* seeds
		2 *Helianthus* seeds
Unit 75		
Feature 5A	pit structure	1 piece *Prosopis* charcoal

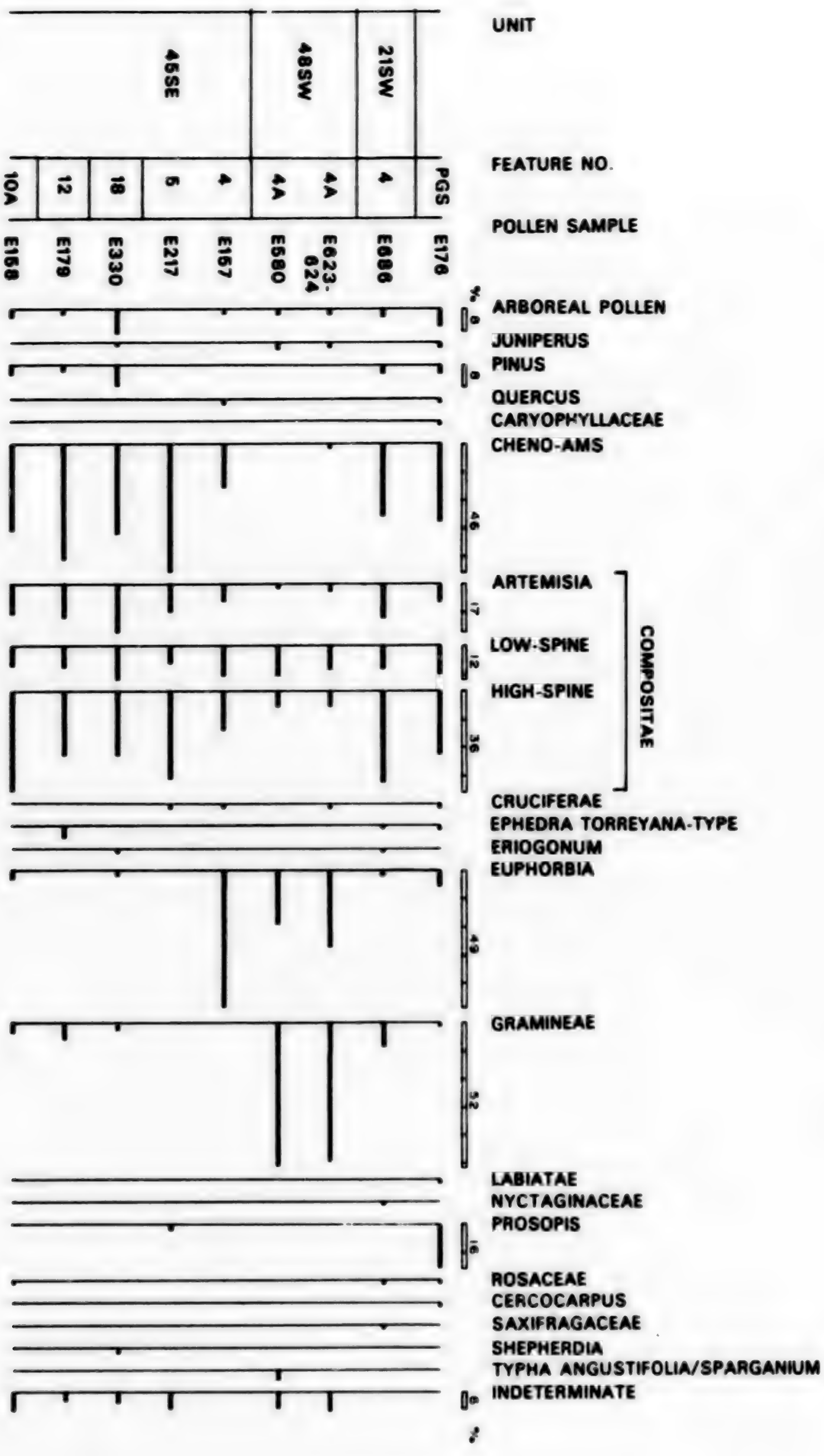


FIGURE 9.26.

POLLEN DIAGRAM FOR EXCAVATED FEATURES.

perhaps indicates processing of sunflower seeds. Sunflower seeds are listed by Wetterstrom (1980:Table 10) in seven samples from hearths at "small camps" in the Hueco Bolson but these were not charred and thus presumed not of prehistoric origin.

Sporobulus seeds are exceptionally abundant in several samples, particularly in the interior hearth of Feature 4A. Grass seeds and stems are also abundant in the 4A samples suggesting that rather than seed processing, a more likely explanation for the high frequencies of Sporobulus in the Feature 4A samples is their inclusion with grass stems and leaves in a superstructure. Gramineae pollen (Figure 9.26) is also present in abundance in Feature 4A samples along with a small quantity of Typha pollen; both grass and cattail could have served as construction materials. Typha would have been available along the Rio Grande about 10 miles to the east, and the presence of this species' pollen may indicate importation of roofing materials or possibly of mats made of cattail. An additional pit structure, 21SW - Feature 4, is also distinguished by relatively high grass pollen counts, reinforcing the evidence for grass as roofing material for small huts.

In summary, charred seeds, recovered hearths, and pit structures are few in number and are not overwhelming evidence for the processing of seed products at these features. Charred seeds include those of Portulaca, Amaranthus, Helianthus, and Sporobulus. O'Laughlin observed (personal communication in notes provided with flotation sample analysis results) that burned seeds are of species whose seeds ripen from late spring to late summer, although this should not necessarily imply use of the area only during these seasons. There is evidence for use of mesquite, grass and, possibly yucca and cattail, as pithouse construction materials. Grass stems and seeds occur in three of the pit structure samples and Gramineae pollen is also present in highest frequencies in pit structure samples, while it is absent or present in low frequencies in small hearths and pits.

Burned species and those indicated by pollen spectra are comparable to the those found in the modern vegetation regime and do not imply a major shift in vegetation in this area over the last thousand or more years. For example, features containing dropseed in Unit 48 are situated in an environmental zone of relatively dense grass cover today. This stratum, designated environmental Zone 3A by Nials (see Chapter 2), is described as a high relief yucca dunes zone and much of it is visible on aerial photographs as more densely vegetated than other photointerpreted strata. During survey, grass cover in the eastern half of Unit 48 and the southeastern one third of Unit 48SW was noted to be dominated by Sporobulus. The presence of charred Sporobulus seeds in samples from Unit 48, especially those containing low frequencies of charred seeds, may therefore result because of their relative abundance in the past environment.

In addition, photointerpretation of Zone 3 (see Chapter 2) has indicated that this zone appears as a series of parabolic dunes overlain atop one another. If this is so, and the abundance of Sporobulus seeds indicates the generally deeper sand blanket of parabolic dune fields, then dune formation in Zone 3 may be a recurring phenomenon, one characterizing prehistoric periods as well as the recent past. The presence of abundant burned and unburned Sporobulus seeds only in Unit 48 samples, the modern location of such dune cover, may be evidence for recurring episodes of dune formation during the last 2,000 years in this region.

Faunal remains recovered from excavations are limited to three small charred bone fragments from 21SW 4 Feature. They include a first phalanges and a right distal epiphysial fragment probably from a jackrabbit (Lepus californicus). Due to its very small size, a third fragment probably belonging to a small mammal like rabbit, could not be identified. The scarcity of bone in pit and hearth fill from features on the West Mesa may be due to poor preservation of organic materials in shallow deposits. In addition, many features, such as pit structures and roasting pits, may have served functions other than ones which involved cooking game. Given these considerations, an in-depth examination of the kinds of game which may have been targeted for use in this area would require that an extremely large number of features be sampled.

EXCAVATED ARTIFACTS

At least one artifact was recovered from each of the 28 excavated features (Table 9.5). FAR

BLANK

PAGE

Table 9-5 . Artifact class frequencies by unit and excavation feature.

Provenience Frequency	Type				FAR Weight (gm)
	Ceramic	Groundstone	Lithic	FAR	
21NE - 4	0	1	0	1	
21SW - 4	2	0	1	67	
45SE - 2	0	3	87	93	2,190 Fea 2A, 1110 Fea 2D
45SE - 3,7,15	0	20	163	82	5,075 Fea 3
45SE - 4,14	0	13	4	121	12,035 Fea 4
45SE - 5	0	11	15	109	6,145 Fea 5
45SE - 8	0	4	46	13	
45SE - 10	0	0	1	0	
45SE - 11	1	0	28	0	
45SE - 12	0	1	36	0	
45SE - 13	0	3	26	7	
45SE - 16	0	2	30	2	
45SE - 17	0	2	16	6	
45SE - 18	0	1	3	18	
45SW - 3	0	0	3	0	
45SW - 4	0	0	2	0	
48NW - 2,3	30	9	17	30+	2,870 Fea 2
48NW - 5	4	0	4	1	
48NW - 6	2	0	3	0	
48SW - 1,3,4	154	18	131	27	
50 - 4	0	0	3	0	
75 - 5	0	8	61	15	

counts are given for all features and weights given for burned rock at those features either containing burned rock or at which surficial concentrations of burned rock were present. FAR in dispersed surface scatters in the feature vicinity was not weighed. Ceramics and chipped stone and groundstone artifact types recovered during excavations are listed in Tables 9.6, 9.7 and 9.8, respectively. No in-depth comparisons of excavation collections have been attempted, rather analytical comparisons of feature assemblages in the following sections focus on all features located during the intensive survey using excavation results to assess analysis conclusions.

As can be seen from Table 9.8, few ceramics were recovered from most features. This is not surprising since areas containing high artifact densities which include abundant ceramics were systematically excluded from the intensive survey. High ceramic frequencies in the collections recovered from Features 1, 3, and 4 in Unit 48SW -- three pit structures dating to between A.D. 430 and 1060 -- are coupled with a higher variety of types than exhibited by other, smaller collections. No bowl sherds were recovered at excavated features.

One comparison of the chipped stone attempted here follows the line of investigation in Chapter 6 which compares lithic material types and flake morphology among assemblages from associations assigned to different periods and phases on the basis of time-diagnostic artifacts. Chipped stone artifact and material types are compared among three groups of features from dated contexts. The first group includes pit structures dating prior to 950 B.C., the second a pit structure and pits dated to between A.D. 115 and 325, and third pitstructures dating subsequent to A.D. 500. For the sake of distinguishing among these groups, they are termed, "Archaic", "Late Archaic" and "Mesilla Phase", respectively.

Similarities among the combined chipped stone assemblages from features in each group include a predominance of cryptocrystalline flakes in each assemblage (Tables 9.9 - 9.11). Differences include higher proportions of crystalline volcanic and sedimentary angular debris in the Mesilla Phase assemblage as compared to the Archaic which contains very high proportions of cryptocrystalline angular debris. Abundant cryptocrystalline angular debris could be attributed to chipped stone tool or core recycling. A high incidence of angular debris in sedimentary and volcanic rock categories in the Mesilla Phase assemblage (almost all of this material from the Unit 48SW pit structure complex) may indicate more groundstone recycling at this location. In contrast, the total lack of sedimentary (primarily sandstone) debris at five Archaic pit structures is interesting but at this point not readily explainable.

Taking the comparisons a bit further, flake stage was calculated for complete flakes in each assemblage. No major differences exist between flake size and stage (as measured by amount cortex cover, dorsal scar count, platform attributes and size) among the groups (Table 9.12). The highest flake stage measure is for "Late Archaic" assemblages, most of the flake material being associated with pits rather than pit structures. This pattern may indicate tool maintenance and reworking at nonresidential field locations in contrast to flakes originating from a wider array of core stages at pit structures regardless of period of occupation. These and other differences and similarities in chipped stone assemblage content are pursued below.

SURVEYED FEATURES AND ASSOCIATED SURFACE ARTIFACTS

Surveyed features are listed in Table 9.13 by survey area and survey unit. The larger Area 3 survey units in this table are broken down into 400 x 400 meter quadrats. The estimated dimensions of subsurface features and the presence of FAR is indicated for features in all survey units. If the feature was excavated, this is also noted along with a brief characterization, i.e., pit, pit structure.

Feature testing was accomplished during the Phase II survey by sampling the soft, sandy paleosol surface with a 1 inch diameter soil probe to obtain feature dimensions. Unless partially covered by a sand dune, upper levels of features that had been excavated into the paleosol rarely exceeding 10 centimeters in depth from the sandy ground surface. There has not been any appreciable soil development on the interdunal surfaces to inhibit visibility of burned features or those containing charcoal and ash once loose surface sands had been cleared (Earle 1987).

Table 9.6. Cross tabulation of excavated features and chipped stone type.

UNIT/ FEATURE	CHUNK	TST COBBLE	NPLAT CORE	ANG DEBRIS	DIST FLAKE FRAG	UNDIFF FLAKE	BFT FLAKE	PRESS FLAKE	BIPLR FLAKE	UNIFACE 2	BIFACE UNDIFF	BIFACE 1		
21SW-4	0	0	0	0	0	1	0	0	0	0	0	0	0	1
45SE-10	0	0	0	0	0	1	0	0	0	0	0	0	0	1
45SE-11	0	0	0	3	4	17	0	3	0	0	0	1	0	28
45SE-12	0	0	0	3	7	14	1	9	1	1	0	0	0	36
45SE-13	0	0	0	4	3	17	0	2	0	0	0	0	0	26
45SE-16	0	0	1	8	5	9	0	7	0	0	0	0	0	30
45SE-17	0	0	0	2	2	11	1	0	0	0	0	0	0	16
45SE-18	0	0	0	0	0	2	0	1	0	0	0	0	0	3
45SE-2	0	0	0	17	10	50	5	4	0	0	0	1	0	87
45SE-3,7,15	3	0	0	25	25	92	3	12	1	0	0	1	1	163
45SE-4	2	0	1	1	0	0	0	0	0	0	0	0	0	4
45SE-5	1	0	1	4	1	6	1	1	0	0	0	0	0	15
45SE-8	0	0	0	12	6	23	1	4	0	0	0	0	0	46
45SW-3	0	0	0	0	1	2	0	0	0	0	0	0	0	3
45SW-4	0	0	0	0	0	2	0	0	0	0	0	0	0	2
48NW-2,3	0	0	0	1	0	15	0	0	0	0	1	0	0	17
48NW-5	0	0	0	1	0	2	1	0	0	0	0	0	0	4
48NW-6	0	1	0	0	0	2	0	0	0	0	0	0	0	3
48SW-1,3,4	2	0	1	26	13	69	3	17	0	0	0	0	0	131
50-4	0	0	0	2	0	1	0	0	0	0	0	0	0	3
75-5	0	1	0	12	13	28	3	4	0	0	0	0	0	61
TOTAL	8	2	4	121	90	363	19	64	2	1	1	1	1	680

Table 9.7. Crosstabulation of excavated features and groundstone types.

UNIT	UNDIFF METATE FRAG	SLAB METATE FRAG	BASIN METATE FRAG	UNDIFF MANO FRAG	OVATE HDSTONE	MANO GRNDING SLAB	UNDIFF HMSTN	SPHR HMSTN CMPLT	OBLNG HMSTN	IRR HMSTN	INDET FRAG	TOTAL
21NE-4	0	0	0	1	0	0	0	0	0	0	0	1
45SE-12	0	0	0	0	0	0	0	0	0	0	1	1
45SE-13	0	0	0	0	0	0	0	0	0	0	3	3
45SE-16	0	0	0	0	0	0	0	0	0	0	2	2
45SE-17	0	0	0	0	0	0	0	0	0	0	2	2
45SE-18	0	1	0	0	0	0	0	0	0	0	0	1
45SE-2	0	0	0	0	0	0	0	0	0	0	3	3
45SE-3,7,15	0	3	0	0	0	0	2	0	0	*1	14	20
45SE-4	4	0	0	0	1	0	0	0	1	0	7	13
45SE-5	0	0	1	2	0	1	1	0	0	*1	5	11
45SE-8	0	0	0	0	*1	0	0	0	0	0	3	4
48NW-2,3	0	0	0	0	0	0	0	0	0	0	9	9
48SW-1,3,4	0	0	1	1	0	0	0	1	0	1	14	18
75-5	0	0	0	0	0	0	0	0	0	1	7	8
TOTAL	4	4	2	4	2	1	3	1	1	4	71	97

* COMPLETE

BLANK
PAGE

Table 9.8 Frequencies of ceramic types by unit and excavation feature. Sherd frequencies given first for sherds of indeterminate vessel form followed by / and jar sherds.

	Type								
Provenience Frequency	Unspecific El Paso Brownware	El Paso Brownware	El Paso Polychrome	El Paso Bichrome	Uniden. Mimbres Whiteware	Fine Tempered Polished	Oblit. Corr Brownware	Uniden.	Totals
21SW - 4					2				2
45SE - 11	1								
48NW - 2,3	21			1/1	4	4			30
48NW - 5	4								4
48NW - 6	2/2								2
48SW - 1,3,4	133/6	5/5*	2/2*	7/3	1/1			1	154
Totals	161	5	2	8	1	11	4	1	192

*Jar Rim Sherds

Table 9.9. Material and chipped stone tool types for features radiocarbon dated prior to 550 B.C.

	Material Type						
Type	GVOL	CVOL	QTZ	CCS	SED	OTHER	Total
Angular Debris	0.0	14.29	11.43	74.29	0.0	0.0	35
Flake Fragments	0.0	37.50	8.33	50.00	0.0	4.17	24
Flakes	7.41	27.78	3.70	58.33	1.85	0.60	108
Biface 1,2	0.0	0.0	100.0	0.0	0.0	0.0	1
Cobble	0.0	0.0	0.0	0.0	0.0	100.0	1
Totals	4.73	26.04	6.51	59.76	1.18	1.78	169

Table 9.10. Material and chipped stone tool types for features radiocarbon to A.D. 325.

	Material Type						
Type	GVOL	CVOL	QTZ	CCS	Total		
Angular Debris	0.0	0.0	0.0	100.000	4		
Flake Fragments	0.0	0.0	0.0	100.00	7		
Flakes	3.23	22.58	3.23	70.97	31		
Uniface 1,2	0.0	0.0	100.0	100.00	1	0.0	1
Total	2.33	16.28	2.33	79.07	43	1.78	169

Table 9-11. Material and chipped stone tool types for features radiocarbon dated subsequent to A.D. 1050.

Type	Material Type						Total
	GVOL	CVOL	QTZ	CCS	SED	Other	
Angular Debris	0.0	23.08	11.54	38.46	26.92	0.0	26
Flake Fragments	7.14	35.71	0.0	57.14	0.0	0.0	14
Flakes	4.49	25.84	5.62	61.80	1.12	1.12	89
Cores	0.0	0.0	100.0	0.0	0.0	0.0	1
Cobbles	0.0	0.0	0.0	0.0	50.00	50.00	2
Total	3.79	25.76	6.06	56.06	6.82	1.52	132

Table 9.12. Flake length and stage comparisons.

Features	Flake Stage		Flake Length	
	Mean	N	Mean	N
Archaic	5.13	71	12.80	87
Late Archaic	5.79	16	11.83	24
Mesilla Phase	5.43	66	10.47	80

Clearing the unconsolidated surface sand exposes both the feature surface and the paleosol. Table 9.13 also lists results of the testing program.

Surficial Artifact Assemblages at Features

Artifact assemblages associated with 141 features discovered through Phase II survey can be compared to each other and to assemblages of spatially associated artifacts (with and without features) described in Chapter 8. To accomplish this comparison the surficial artifact assemblage recorded by the intensive survey was inventoried from a 10 x 10 meter grid centered over each feature using the Phase II feature marker as a center point.

The analysis of grid content is identical to the one undertaken for spatial associations: counts of 14 lithic classes were calculated for assemblages in each feature grid and compared using a hierarchical cluster analysis (Ward's Method, see Chapter 8 for a complete description of the methods involved). Eleven groups of feature assemblages were obtained with the cluster analysis. Like the analysis of surface assemblages presented in Chapter 8, feature morphology and ceramics in grids were not included in the cluster analysis and are compared among assemblages as independent lines of investigation. Table 9.14 lists the 11 assemblage groups obtained with the cluster analysis.

Feature grids take in a much larger area (100 meters2) than do most spatial associations analyzed in the previous section (the mean area of spatial associations is 50 meters 2). Comparing the surface assemblages analyzed in Chapter 8 with feature assemblages analyzed in this chapter, there are several general differences. First, mean carbonate and noncarbonate FAR counts in feature grids are expectably high, averaging about 7 pieces of FAR per 10 square meters at features with high densities of FAR compared with highest average FAR densities of about 3 per 10 square meters in spatial associations. Mean noncarbonate FAR and fire-altered groundstone densities are also more than twice as high in many feature grids as they are in spatial associations. This is also true for incomplete groundstone, and may be due to reuse of groundstone artifacts as hearth elements. Notably, cores and formal tools are fewer in the feature grids. Flakes of all types and angular debris also appear to be more abundant when the entire study area is considered than when examining only areas around features. Less abundant chipped stone in the vicinity of features may be due to the recycling of these artifacts at reused facilities, as well.

Differences in ceramic abundance also obtain for feature-oriented grid assemblages versus assemblages of spatially clustered items. Over 40 percent of the feature grids (those in Clusters 1, 3, and 4) average above 2 sherds per 10 square meters. Average sherd densities are comparable or higher for less than 1 percent of all spatial associations. Sherd densities are about 1.5 or lower per 10 square meters in the majority of spatial associations. Looking at ceramic densities another way (Table 9.15), feature grids contain evidence of Formative period occupation more often than expected when compared to all spatial associations. For example, about 7 percent of all spatial associations could be classed as Late Ceramic while over 15 percent of the feature grids contain El Paso Phase ceramics indicating use of these places at least once during the ceramic period.

If features are more likely to be associated with ceramics than areas lacking features, it also appears as if ceramic period occupations on the West Mesa focused on the frequent use and reuse of hearths, pits, and pit structures. Investment in facilities may have been more intensive during the Formative than during preceding occupations due to focused reuse of places from permanent residences lying off the West Mesa. This observation is, at best, speculative, since it presupposes a constant intensity of use of the Mesilla Bolson throughout the prehistoric occupation. Higher population densities as proposed for the Formative period (Carmichael 1983a; Whalen 1977,1978) may be responsible for the more frequent use of features during this period in all portions of the El Paso region. Even without differences in population density between the Formative and earlier periods, features constructed during the Archaic period may simply be less well-preserved, and thus fewer in number than those of later periods. Neither of the above scenarios, however, explain why ceramics would be more abundant at features than at locations lacking constructed facilities.

Table 9.13. Dimensions of subsurface deposits and presence of FAR at tested features.

AREA I

UNIT	FEATURE	FCR	STAIN	N-S	E-W	DEPTH	SHAPE	OTHER
1	15	—	BLACK	60+	?	30+	UNKNOWN	

UNIT	FEATURE	FCR	STAIN	#CORES	GRID SIZE	DEPTH TO CALICHE/SAND	SIZE
1	1	X	—	10	50CM	8-15	75CM DIA
	2	X	—	5	50CM	1-4	70CM "
	3	X	—	9	50CM	2-3	75 X 50
	4	X	—	9	50CM	10-20	125 X 100
	5	X	—	11	75CM	3-10	75 X 100
	6	X	—	8	75CM	3-8	50 X 150
	7	X	—	15	100CM	5-10	4 X 4M
	8	X	—	10	75CM	3-8	75CM DIA
	9	X	—	20	100CM	2-10	4 X 5M
	10	X	—	12	100CM	5-15	3 X 4M
	11	X	—	NOT RELOCATED			
	12	X	—	12	75CM	5-12	50 CM DIA
	13	X	—	17	100CM	2-5	5 X 5M
	14	X	—	12	50CM	2-8	75CM DIA

AREA II

UNIT	FEATURE	FCR	STAIN	N-S	E-W	DEPTH	SHAPE	OTHER
25	1	X	—	—	—	—		
	2	X	—	—	—	—		
	3	X	—	—	—	—		
	4	X	—	—	—	—		
	5	—	LIGHT	MODERN HEARTH				
	6	—	MOD				NOT TESTED	
32	1	X	—	—	—	—		
50	1	X	—	—	—	—		
	2	—	GREY	55	25	5	IRREGULAR	
	3	—	ORGANIC	35	30	1		
	4	—	BLACK	225	215	30+	ROUND	EXCAVATED PIT STRUCTURE
	5	X	—	—	—	—		
	6	-	DARK	?	?	32	UNKNOWN	MAY BE PARTIALLY ORGANIC
75	1	X	BLACK	65	30	7	IRREGULAR	
	2	X	—	—	—	—		
	3	—	BLACK	160	75	14	OVAL	
	4	X	—	—	—	—		
	5	—	BLACK	220	210	30+	OVAL	EXCAVATED PIT STRUCTURE
	6	X	LIGHT	55	50	2	IRREGULAR	
	7	—	DARK	240	250	16+	UNKNOWN	
	8	—	DARK	160	140	3	IRREGULAR	
110	1	X	—	—	—	—		
	2	X	—	—	—	—		
	3	X	—	—	—	—		
	4	—	DARK	36	21	1.5	IRREGULAR	

AREA III

3NE	1	X	DARK	50	50	30	ROUND	CHARCOAL
	2	-	-	-	-	-	-	SHERDS
	3	X	-	-	-	-	-	
	4	X	LIGHT	35	60	15	OBLONG	
	5	X	-	-	-	-	-	
	6	X	-	-	-	-	-	
	7	X	LIGHT	50	50	15	UNKNOWN	
	8A	X		30	40	30	ROUND	
	8B	X	LIGHT	30	20	12	ROUND	
	9	-	X				NOT TESTED	
	10	-	X				NOT TESTED	
3NW	1	X	LIGHT	25	15	0	ROUND	
	2	X	-	-	-	-	-	
	3	-	VERYLIGHT-		-	-	-	
	4	-	DARK	100	100	15	IRREGULAR	
	5	-	LIGHT				NO STAINING PRESENT WHEN TESTED	
	6	-	DARK	50	30	10	IRREGULAR	
3SE	1A	-	DARK	500	400	30	UNKNOWN	
	1B	X	-	40	80	0	OVAL	
	2	X	-	-	-	-	OVAL	
	3	X	LIGHT	50	50	17	OVAL	
	4	X	-	-	-	-	DISPERSED	
	5	-	DARK	75	50	17	ROUND	
	6	-	DARK	110	55	10	OVAL	CHARCOAL
	7	X	BLACK	45	40	11	ROUND	
	8	X	DARK	70	60	11	AMORPHOUS	CHARCOAL
	9	-	BLACK	45	50	0	ROUND	
	10	X	DARK	25	25	11	ROUND	
	11	X	-	-	-	-		
	12	X	-	-	-	-		
	13	X	-	-	-	-		
	14	X	-	-	-	-		
	15	X	LIGHT	30	40	7	OVAL	
	16A	X	-	-	-	-	-	
	16B	X	-	-	-	-	-	

Table 9.13 (continued)

UNIT	FEATURE	FCR	STAIN	#CORES	GRID	SIZE	DEPTH TO CALICHE/SAND	SIZE
	17	X	-	-	-	-	-	
	18	-	X				NOT TESTED	
	19	-	X				NOT TESTED	
21NW	1	X	BLACK	260	510	6	IRREGULAR	
	2	-	MOD	100	100	10	UNKNOWN	
	3A	-	BLACK	100	117	8	ROUND	
	3A'	X	-	-	-	-	DISPERSED	
	3B	X	MOD	75	80	0	ROUND	
	4	X	-	60	70	0	DISPERSED	
	5						NUMBER NOT USED	
	6	X	BLACK	210	270	22	UNKNOWN	
	7	X	-	120	130	0	DISPERSED	
	8	-	BLACK	80	70	12	IRREGULAR	
	9	-	DARK	80	70	6	OVAL	
	10	-	BLACK	100	140	20+	OVAL	
	11A	-	MOD	32	40	3	ROUND	
	11B	-	MOD	50	33	0	ROUND	
21SW	1	X	-	100	60	0	IRREGULAR	
	2	X	-	128	170	0	IRREGULAR	
	3	X	DARK	104	140	8	ROUND	
	4A*	X	BLACK	170	213	14	OVAL	EXCAVATED PIT STRUCTURE
	4B	-	DARK	104	93	14	IRREGULAR	EXCAVATED HEARTH
21NE	1	X	-	150	200	0	IRREGULAR	
	2	-	LIGHT	140	85	4	IRREGULAR	
	3	X	-	400	300	0	DISPERSED	
	4	-	DARK	97	84	15	OVAL	EXCAVATED HEARTH
	5	X	DARK	2	1	2	IRREGULAR	
21SE	1	X	-	100	50	0	DISPERSED	
	2	X	-	200	60	0	DISPERSED	
	3	X	-	60	60	0	DISPERSED	
	4	X	BLACK	85	72	17	OVAL	
	5						NUMBER NOT USED	
	6	X	-	200	100	0	DISPERSED	
	7	X	MOD	150	200	5	"V" SHAPED	
	8	X	MOD	120	70	10	UNKNOWN	
		-	LIGHT	50	84	2	IRREGULAR	
	10	X	-	430	50	0	DISPERSED	
	11	-	LIGHT	27	20	3	OVAL	
45NE	1	X	-	-	-	-		
	2	X	GREY	160	6	4	UNKNOWN	
	3	X	-	50	180	?	UNKNOWN	
	4	X	-	-	-	-	UNKNOWN	
	5A	-	DARK	100	120	15	ROUND	
	5B	-	DARK	50	50	10	ROUND	
	6	X	GREY	130	100	6	UNKNOWN	CHARCOAL
	7	X	-	-	-	-	-	
	8	-	MOD				NOT TESTED	
	9	X	-	-	-	-	-	
	10	X	LIGHT	80	110	0	UNKNOWN	
45NW	1	X	-	-	-	-	-	
	2	X	MOD	70	65	10	ROUND	
	3	X	-	-	-	-	-	
	4	-	DARK	185	200	12	UNKNOWN	
	5	-	LIGHT	120	90	6	UNKNOWN	
	6	-	X				NOT TESTED	
45SW	1	X	-	-	-	-	-	
	2	X	-	-	-	-	-	
	3	-	DARK	120	130	20	ROUND	EXCAVATED PIT STRUCTURE
	4	-	MOTTLED	120	60	2	IRREGULAR	EXCAVATED PIT

AREA III

UNIT	FEATURE	FCR	STAIN	N-S	E-W	DEPTH	SHAPE	OTHER
45SE	1	X	LIGHT	70	33	0	OVAL	
	2A	X	MOD	55	60	15	CIRCULAR	EXCAVATED PIT
	2B	X	MOD	80	60	10	IRREGULAR	EXCAVATED PIT
	2C	X	DARK	300	150	30	ELONGATE	EXCAVATED PIT
	2D	X	DARK	PART OF 2C ON SURFACE				EXCAVATED PIT STRUCTURE
	3	X	LIGHT	220	70	1	IRREGULAR	EXCAVATED FCR/ASH ASSOCIATION
	4	X	DARK	55	50	5	CIRCULAR	EXCAVATED PIT
	5	X	DARK	55	55	10	CIRCULAR	EXCAVATED PIT
	6	X	--	150	150	0	CIRCULAR	
	7	-	MOD	33	30	5	CIRCULAR	EXCAVATED PITS
	8	-	MOD	50	60	15	IRREGULAR	EXCAVATED PIT STRUCTURE
	9	X	—	150	150	0	CIRCULAR	
	10	-	DARK	80	80	35	CIRCULAR	EXCAVATED PIT
	11	-	MOD	50	46	10	CIRCULAR	EXCAVATED PIT
	12	-	DARK	165	175	47	CIRCULAR	EXCAVATED PIT
	13	-	DARK	75	70	20	CIRCULAR	EXCAVATED PIT STRUCTURE
	14	-	DARK	40	50	9	OVAL	EXCAVATED PIT
	15	-	LIGHT	100	100	0	IRREGULAR	EXCAVATED POSSIBLE PIT STRUCTURE
	16	-	DARK	93	127	5	OVAL	EXCAVATED PIT
	17	-	LIGHT	160	130	2	IRREGULAR	EXCAVATED POSSIBLE PIT STRUCTURE
	18	-	DARK	90	30	30+	CIRCULAR	EXCAVATED PIT
48SW	1	-	MOD					EXCAVATED PIT STRUCTURE

Table 9.13 (continued)

	2	-	LIGHT	250	200	25	IRREGULAR	
	3	-	DARK					EXCAVATED PIT STRUCTURE
	4	-	DARK					EXCAVATED PIT STRUCTURE
	5	-	LIGHT	60	30	8		
	6	-	LIGHT	210	200	2	UNKNOWN	
480W	1	X	DARK	100	150	2+	UNKNOWN	
	2	X	LIGHT	75	65	3	IRREGULAR	EXCAVATED FAR/SURFICIAL
STAIN								
	3	X	LIGHT	60	50	5	OVAL	EXCAVATED SURFICIAL
STAIN								
	4	X	-	-	-	-	-	
	5	-	MOD	70	65	15	OVAL	EXCAVATED POSSIBLE PIT STRUCTURE
	6	-	MOD	100	70	10	IRREGULAR	EXCAVATED PIT

Table 9.14. Mean lithic and groundstone frequencies of eleven assemblage groups obtained through a cluster analysis of feature assemblages.

	ANGDEB	BIPFLK	BFTFLK	UNDIFFLK	LTSTAGE	SMCORE	LRGCORE	FORMTOOL	UTILFLK	GSINCMPL	CMPMANO	CMPHMST	GSFAR	NONCBFAR	C*ARBNFAR	C*ERAMICS
1	1.40	.10	.03	2.10	.35	.20	.00	.00	.13	.85	.00	.05	.08	1.75	31.58	21.37
2	.09	.10	.06	1.70	.30	.03	.00	.03	.23	.70	.00	.06	.20	7.80	69.63	3.60
3	.72	.00	.00	.90	.45	.00	.00	.00	.09	4.72	.00	.00	.27	2.81	33.00	22.36
4	1.27	.00	.00	1.63	.54	.00	.00	.00	1.36	.72	.00	.00	.00	1.54	43.72	21.45
5	1.42	.28	.28	3.00	1.71	.28	.00	.00	.14	4.14	.00	.00	.57	46.14	42.85	2.57
6	.81	.09	.18	.72	.27	.00	.00	.00	.09	3.36	.00	.00	2.47	2.36	16.18	2.81
7	12.31	3.12	.56	29.43	9.25	1.37	.00	.37	1.93	5.00	.00	.50	.25	7.50	55.25	5.18
8	5.00	.75	.12	7.87	2.12	.00	1.25	.00	1.00	5.62	.00	.00	1.25	2.75	23.25	17.12
9	6.00	.33	2.00	4.33	3.66	.00	.00	.00	.33	.66	.00	1.00	.00	.67	4.30	.00
10	.66	.00	.00	5.00	1.33	.33	.00	.00	1.00	6.33	1.00	.00	2.66	6.67	19.00	0.00
11	1.00	.00	.00	.00	.00	.00	.00	1.00	.00	.00	.00	.00	.00	.00	39.00	50.00

NOTE: *Not included in the cluster analysis.

Table 9.15. Feature assemblages by period and phase.

Cluster	Period and Phase						Total	
	Unspec Lithic	Unspec Ceramic	Lithic Late	Early Ceramic	Late Ceramic	Mixed		
1	31.70	24.39	4.87	7.31	17.07	17.07	41	29.08
2	36.66	36.66	10.00	3.33	6.66	6.66	30	21.28
3	27.27	9.09			27.27	36.36	11	7.80
4	54.54	9.09		9.09		27.27	11	7.80
5	42.85	14.28			42.85		7	4.96
6	63.63	9.09			9.09	18.18	11	7.80
7	18.75	43.75			18.75	18.75	16	11.35
8	50.00	12.50			25.00	12.50	8	5.67
9	67.67		33.33				3	2.12
10	100.00						3	2.12
11					100.00		1	0.70
Totals	54	33	6	5	22	21		141
Percent	38.30	23.40	4.26	3.55	15.60	14.89		
Percent All Spatial Associations	70.21	15.98	1.89	1.11	7.46	2.84		1796

Focused reuse of facilities by ceramic period occupations would account for this pattern.

Feature Assemblage and Feature Type Correlations

In assessing whether residential structures, i.e., pit structures, occur more often with one type of assemblage than with another, feature assemblages that were grouped by the cluster analysis are compared in this section with sets of data that are independent of the lithic classes used in the cluster analysis. The cluster analysis of feature assemblages relies on classes of chipped stone and groundstone tools and debris which inform about tool production, use, maintenance, and recycling. The types of constructed features associated with assemblages, the abundance of carbonate FAR at features, the frequency of ceramics, the variety of ceramic types, and ratio of bowl to jar sherds in assemblages each provide independent sets of data with which to evaluate assemblage groups. Examining these independent data, the assemblage clusters can be discussed as five groups which vary with respect to ceramic and FAR abundance and, importantly, the types of features associated with assemblages.

The most direct independent line of investigation into the occupational history of feature assemblages compares the attributes of tested features, the size and depth of tested ash and charcoal deposits indicative of buried features, and excavated features with artifact assemblages. Assemblage groups are compared first on the basis of the number of tested features measuring greater than 1 meter in maximum dimension (Table 9.16). A deposit of ash or charcoal stained soil 1 meter in diameter is not a particularly large area but is used here to delimited those locations which potentially contain multiple features and pit structures. Relatively extensive ash-stained surfaces are common indications of multiple features. Pit structures are variable in size, but of the 14 pit structures excavated in the NHLEP area (three of these were recently excavated by Office of Contract Archaeology, O'Leary personal communication and the rest by this project) initial tests estimated maximum feature dimensions as larger than 1 meter for all but three. Excavated features are then described for each assemblage group.

The density of features on the West Mesa is in all probability much higher than indicated by feature densities recorded through the Phase II intensive survey. Evidence for this assertion comes from several excavation units which were enlarged beyond the limits of the originally recognized feature encountering a complex of others not initially located during the Phase II survey. Had all excavation units been more horizontally extensive and test trenches been placed at systematic intervals within these units, it is likely that additional burned and unburned features may have been located.

In the following sections assemblages will first be described, types of tested features associated with each group are then discussed, and descriptions of excavated features given. Major correspondences between feature content and feature type can be seen with Group I, II, and III assemblages. Group I assemblages are characterized as additive in that a continual buildup of debris is coupled with increased variety in assemblages. These assemblages are associated with a high incidence of pit structures. Group II assemblages may also be additive in the above sense but occur with multiple features which lie in close proximity to one another. The additive structure of these assemblages may thus be attributed to their composite histories. Group III assemblages are not additive evidencing no strong correspondence between debris density and variety. The structure of these assemblages is interpreted as stemming from intensive reuse and recycling. Pits are the only excavated features occurring with Group III assemblages.

Group I

Lithic assemblages in Group I include those in Clusters 1, 4, and 8. Moderate frequencies of flakes and angular debris distinguish this group with Clusters 4 and 8 containing relatively high frequencies of incomplete groundstone (Table 9.14). Fire-altered groundstone and noncarbonate FAR are not particularly abundant at features in this group, but carbonate FAR occurs in moderate frequencies. Clusters in this group average high ceramic frequencies as well as a moderately high variety of ceramic types. The structure of Group I assemblages as revealed by the relationship between item densities in the 10 x 10 meters feature grids and the variety of chipped stone

Table 9.16. Tested feature dimensions and FAR frequencies (carbonate and noncarbonate rock) at clustered features.

CLUSTER 1	FAR	STAIN DIMENSIONS
3SE-3	80	50 X 50 X 10
3SE-6	46	110 X 55 X 10
3SE-9	5	45 X 50 X 1
3SE-17		70
3SE-16	49	
3SE-13	34	
3SE-1	62	500 X 400 X 30
3NW-6	1	50 X 30 X 10
3NW-3	0	EPHEMERAL
3NE-7	30	50 X 50 X 15
3NE-6	67	
3NE-4	71	35 X 60 X 15
3NE-1	67	50 X 50 X 30
25-1	9	
21SW-2	25	
21SE-10	140	
21NW-6	35	210 X 270 X 22
21NW-11	10	32 X 40 X 3
21NW-1	176	260 X 510 X 6
21NE-5	16	2 X 1 X 2
1-9	136	
1-7	101	
1-10	31	
1-11	17	
45NE-10	21	80 X 110 X 0
45NW-6	2	NOT TESTED
45SE-1	34	70 X 33 X (1
45SE-18	1	90 X 30 X 30+ EXCAVATED HEARTH/PIT
45SE-5	38	55 X 55 X 10 EXCAVATED PIT
48NW-1	6	100 X 150 X 2+
48NW-4	4	
48NW-5	3	70 X 65 X 15 EXCAVATED PIT STRUCTURE
48NW-6	0	100 X 70 X 10 EXCAVATED HEARTH
48SW-1	16	NOT TESTED EXCAVATED PIT STRUCTURE
48SW-3	16	NOT TESTED EXCAVATED PIT STRUCTURE
48SW-4	14	NOT TESTED EXCAVATED PIT STRUCTURE
48SW-5	0	60 X 40 X 8
75-3	0	160 X 75 X 14
75-6	23	55 X 50 X 2

CLUSTER 2	FAR	STAIN DIMENSIONS
45SE-13	24	75 X 70 X 20 EXCAVATED PIT STRUCTURE
45NE-4	150	
45NE-6	141	130 x 100 x 6
45NE-7	181	
45NE-8	144	
45NW-11	70	
45NE-1	19	
3SE-4	12	
3SE-11	68	
3SE-12	61	
3SE-15	86	30 x 40 X 7
3SE-2	51	
21SE-9	28	50 X 84 X 2
3NE-8	79	
3NE-3	133	
3NE-5	44	
25-5	1	NOT TESTED
21SE-8	94	120 x 70 X 10
3NE-9	157	NOT TESTED
21SE-2	19	
21SE-4	12	85 X 72 X 17
21SE-7	135	150 X 200 X 5
110-3	222	———
21NE-1	38	———
21SE-1	25	———
1-4	67	
1-11	20	
1-2	27	
110-1	38	
110-2	63	

CLUSTER 3	FAR	STAIN DIMENSIONS
75-4	0	
75-8	25	160 X 140 X 3
50-6	14	? X ? X 32
3SE-10	17	25 X 25 X 11
21SW-3	178	
21NW-3	5	100 X 117 X 8
21NW-4	12	
21NE-3	30	———
21NE-4	29	97 X 84 X 15 EXCAVATED PIT
21NE-2	28	140 X 85 X 4

Table 9.16. Tested feature dimensions and FAR frequencies (carbonate and noncarbonate rock) at clustered features.

CLUSTER 4	FAR	STAIN DIMENSIONS	
50-4			
50-2	10	55 x 25 X 5	
50-3	6		
25-6	0	———	MODERN HEARTH
21NW-9	63	80 X 70 X 6	
1-12	32		
1-15	31	60 X ? X 30+	
1-5	118		
1-6	49		
1-7	101		
1-8	125		
21SE-6	64		

CLUSTER 5	FAR	STAIN DIMENSIONS	
21SE-3	110	———	
25-4	26	———	
45NE-2	35	160 X 6 X 6	
45SE-14	126	40 X 50 X 9	EXCAVATED PIT
45SE-4	127	55 X 50 X 5	EXCAVATED PIT
75-1	137	65 X 30 X 7	
75-2	62	———	

CLUSTER 6	FAR	STAIN DIMENSIONS	
48SW-6	0	210 X 200 X 2	
45SW-1	9		
48NW-2	13	75 X 65 X 3	EXCAVATED STAIN/FCR
48-3	14	60 X 50 X 5	EXCAVATED PIT
45SE-10	5	80 X 80 X 35	EXCAVATED PIT
45NW-2	31	70 X 65 X 10	
45NE-3	13		
25-3	5		
3SE-7	20	45 X 40 X 11	
3SE-8	79	70 X 60 X 11	
32-1	15	NOT TESTED	

CLUSTER 7	FAR	STAIN DIMENSIONS	
110-4	24	30 X 21 X 1	
3NW-2	57		
3NW-4	67	100 X 100 X 15	
3SE-14	46		
3SE-18	55	NOT TESTED	
3SE-19	90	NOT TESTED	
3SE-5	58	75 X 50 X 17	
45NW-4	8		
45SE-11	68	50 X 46 X 10	EXCAVATED PIT
45SE-12	43	165 X 175 X 47	EXCAVATED PIT
45SE-15	92	100 X 100 X)1	EXCAVATED POSSIBLE PIT STRUCTURE
45SE-65	62	93 X 127 X 5	EXCAVATED PIT
45SE-3	93	220 X 70 X 1	EXCAVATED FCR/ASH ASSOCIATION
45SE-7	88	33 X 30 X 5	EXCAVATED BASIN-SHAPED PIT
45SE-2D	75	300 X 150 X 30	EXCAVATED PIT STRUCTURE
45SE-8	78	50 X 60 X 15	EXCAVATED PIT STRUCTURE/HEARTH

CLUSTER 8	FAR	STAIN DIMENSIONS	
21NW-10	9	100 X 140 X 20+	
		50 X 33 X)1	
25-2	20		
3NE—2	0		
50-1	21		
45NW-3			
45SE-17	31	160 X 130 X 2	EXCAVATED PIT STRUCTURE
45SE-9	29		

CLUSTER 9	FAR	STAIN DIMENSIONS	
45NE-5	0	100 X 120 X 15	
		50 X 50 X 10	
45SW-3	9	120 X 130 X 30	EXCAVATED PIT STRUCTURE
45SW-4	6	120 X 60 X 2	EXCAVATED PIT

CLUSTER 10	FAR	STAIN DIMENSTIONS	
45NE-9	51		
75-5	5	220 X 210 X 30+	EXCAVATED PIT STRUCTURE
45SE-6	21		

CLUSTER 11	FAR	STAIN DIMENSIONS
3NW-1	30	25 X 15 X (1

and groundstone materials present indicate that "additive" assemblage comprise this group (Table 9.17). Assemblage variety and item densities in grids are correlated in a positive and significant fashion for Clusters 1 and 4.

As described in Chapter 8, additive assemblages may result from variation in the duration of occupation at locations where items are continually introduced -- short-term occupations having assemblages with lower variety and longer-term occupations those with a higher variety of materials. Foraging strategies, by which consumer groups occupying short-term residential bases gather resources as they are encountered, deplete the resources base of an area and then move on, are thought to produce this kind of pattern.

Another factor influencing the additive relationship between variety and density is the presence of debris from residential and non-residential occupations at the same location. A settlement strategy in which residences are reused for other functions produces these kind of composite assemblages. This strategy involves occupation of relatively permanent base camps from which logistically organized groups carry out nonresidential activities at other locations. With the repositioning of the residential base, special purpose tasks may be carried out at the sites of abandoned residences.

Repetition in the base-camp/logistical-camp settlement pattern over the long-term results in complex histories of occupation at locations in systems implementing such strategies.

Turning to the evaluation of the tested features at locations containing Group I assemblages, the percentage of tested features measuring greater than 1 meter in maximum dimension was calculated for the total number of features at which subsurface deposits were present. Over 40 percent of the features in Group I clusters are larger than 1 meter in maximum dimension (Table 9.17). Taken together, half of all Group I assemblages are associated with these larger manifestations of subsurface features.

A high proportion of large tested features is certainly not conclusive evidence for residential structures at the locations of Group I assemblages. Correspondence between large features and the additive character of assemblages in Group I does, however, lend support to the idea that Group I assemblages occur at residences and at places used for more than one function, if large tested features are pit structures and multiple features.

Because only a small sample of features belonging to each cluster was subject to excavation, excavated features cannot be used to completely verify interpretations of the history of assemblage composition. Excavation data can, however, be used to partially assess interpretations of feature occupational history.

Ten of the features in this group were excavated and include: (1) a complex of three pit structures associated with high densities of ceramics, Unit 48SW - Features 1, 3, and 4; (2) a shallow deposit of ashy soil interpreted as a possible pit structure associated with ceramics, Unit 48NW - Feature 5; (3) a moderately large pit interpreted as a hearth and processing feature, Unit 45SE - Feature 18; (4) a shallow pit also interpreted as a hearth, Unit 45SE - Feature 5; (5) a shallow pit interpreted as a possible pitstructure, Unit 45SE - Feature 17; and (6) a basin-shaped deposit of ashy soil, the eroded base of a pit or hearth, Unit 48NW - Feature 6.

The presence of pit structures and the moderately low frequencies of FAR (excluding "outlier" Clusters 9 and 10) suggest that residential functions predominate in this group. The positive relationship between item densities and the variety of lithic artifacts in feature grids also lend support to viewing many features in this group as functioning in domestic tasks and as dwellings. Lack of abundant recycled groundstone in the form of noncarbonate FAR and fire-altered groundstone may be taken as evidence for at least short-term planning by which use of FAR was anticipated to a greater degree than it was at features in some other groups. The chipped stone assemblages in Clusters 1 and 4 are dominated by low frequencies of flakes and angular debris, fragmentary groundstone and by the absence of formal tools -- unifaces, bifaces, or projectile points. Higher flake frequencies including flakes produced late in the reduction sequence and relatively high frequencies of groundstone fragments and fire-altered groundstone in Cluster 8 indicate more intensive

BLANK

PAGE

Table 9.17. Feature assemblage groups organized by assemblage variety/density relationships.

	N	Variety/Density r	p	Mean Ceramic Frequency	Ceramic Variety	Bowl: Jar Sherds*	Mean Carbonate FAR Frequency	Percent Features >1m Max Dimension
Group I								
Cluster 1	40	0.388	0.0178	21.37	2.63	0.23	31.58	46.15
Cluster 4	11	0.653	0.0229	21.45	5.50	0.22	40.00	42.85
Cluster 8	8	0.689	0.0584	17.25	3.00	0.11	75.00	
Group II								
Cluster 2	30	0.681	0.0004	3.60	1.81	0.11	69.63	42.85
Cluster 7	16	0.741	0.0010	5.18	1.20	0.72	55.25	54.54
Group III								
Cluster 3	11	0.373	0.2574	22.36	3.85	0.26	33.00	40.00
Cluster 5	7	0.625	0.1329	2.57	1.50	0.11	42.85	25.00
Cluster 6	11	-0.053	0.1329	2.81	3.00	0.33	16.18	14.28
Group IV								
Cluster 9	3	-----	-----	0.00			4.30	100.00
Cluster 10	3	-----	-----	0.00			19.00	100.00
Group V								
Cluster 11	1	-----	------	50.00	1.00	1.53	39.00	0.00

NOTE: *Based on all sherds.

reuse of groundstone implements, tool maintenance, and possibly production of formal tools at features in this cluster.

Group II

Clusters 2 and 7 make up this group and are distinguished by very low ceramic frequencies. In contrast to Group I assemblages, high frequencies of carbonate and noncarbonate FAR prevail. The relationship between item variety and density in feature grids is strongly positive for assemblages in this group (Table 9.17). With regard to chipped stone, flakes are the most abundant type in assemblages with chipped stone inventories in Clusters 2 and 7 also including some formal tools. Cluster 7 assemblages include very high flake and groundstone frequencies, in contrast to lower frequencies of all items except for fire-altered groundstone in Cluster 2 assemblages.

Looking at the tested features in this group, few features in Cluster 2 exhibited ashy deposits while most in Cluster 7 do. Tested features measuring greater than 1 meter in maximum dimension are over 40 percent of features with subsurface deposits in Group II. FAR is abundant at most features in this group, as well.

The inventory of excavated Group II features offers evidence for the residential and composite nature of assemblages. Excavated features include: (1) a shallow pit structure, Unit No. 45SE - Feature 13. This feature lies in close proximity to an additional pit structure and pit belonging to Cluster 9; (2) a large oval pit structure with an internal hearth, Unit 45SE - Feature 2D. Extramural features at this pit structure include small pits some adjacent to piles of FAR. An additional small pit dug into the upper fill of the pit structure itself is direct evidence for reuse of the location; (3) a complex of two small pits, a surficial ash/FAR association, and a large shallow surficial ash stained surface that may be the remnants of a pit structure, Unit 45SE - Features 3, 7, and 15; and (4) another complex of features comprised of pits of varying dimensions, Unit 45SE - Features 11, 12, and 16. The last two sets of features are evidence for either simultaneous activities carried on adjacent to one another or the reuse of a general locale both resulting in composite histories of use for feature assemblages.

Like Group I assemblages, the variety/density relationships of items in feature grids indicate additive assemblages. Unlike Group I, Group II assemblages are dominated by abundant FAR indicating more emphasis on processing at these locations. The presence of structures and discarded formal tools, which in curated technologies are likely to be discarded at residences rather than at field locations, indicate residential occupation. Residential structures and larger tested deposites, which are additional evidence for the presence of structures, together with the inferred emphasis on processing can be taken together as evidence of the multi-functional histories of assemblages in Group II. Recycled groundstone at Group II assemblages along with abundant FAR indicates an element of planned expedience may have contributed to the accumulation of debris at features in Group II, as well.

This is not to say that some locations in Group I are not multi-functional as well, but simply that the contrast between these two groups is one in which the majority of assemblages in each appear to result from different use histories. In Group I, the weaker variety/density relationships may be the result of the varying durations of residential occupation at features in this group coupled with some reuse of places and the recycling of artifacts that goes along with facility reuse. Group II assemblages are characterized by high densities of artifacts and FAR. High densities of recycled groundstone point to the reuse of artifacts and, by inference, the reuse of places as well. Artifact recycling also indicates that the intended activities of reoccupations may not have included processing, thus the expedient recycling of groundstone as hearth rock. High artifact densities in Group II feature grids may therefore result from the superimposition of debris from separate occupations rather than from prolonged or intensive use of places.

Group III

Group III assemblages lack a strong additive relationship between item density in feature grids and lithic artifact variety of the first two groups (Table 9.17). Moderate to low frequencies of FAR are present in assemblages but

Clusters 3, 5, and 6 in this group are all distinguished by moderately high frequencies of incomplete groundstone. Cluster 5 assemblages have the additional characteristic of very high noncarbonate FAR counts and Cluster 6 assemblages of high fire-altered groundstone counts. Chipped stone inventories for Cluster 3 and 6 include low frequencies of flakes and no cores or formal tools. Cluster 5 lithics include higher frequencies of all flake types but lack formal tools as well. The abundant noncarbonate FAR in Cluster 5 does not represent high frequencies of tiny fragments, rather about 30 percent of this material is larger than 6 centimeters in maximum dimension and less than 1 percent is in the very small size class (0-3 centimeters). (See Table 8.8, all but one of the Cluster 5 feature assemblages are include in Cluster 2 in this table.) Ceramic content of the clusters in this group is variable with Cluster 3 including abundant ceramics and little chipped stone, and Clusters 5 and 6 fewer ceramics and more abundant lithic artifacts. One problem with interpreting the occupational histories of feature assemblages in this group includes the few cases in Cluster 5.

In contrast to Groups I and II, tested features in Group III include 40 percent or fewer large tested features in each of the clusters in this group. Excavated features include pits interpreted as processing features and hearths: (1) a large, shallow pit interpreted as an unlined hearth, Unit 21NE - Feature 4; (2) two shallow pockets of ash stained soil, one associated with abundant FAR, Unit 45SE - Features 4 and 14, (3) Unit 48NW - Features 2 and 3, two large shallow lenses of ash stained soil associated with numerous small pockets of stained soil. (The major concentration of features making up these adjacent features is littered with FAR.); and (4) Unit 45SE - Feature 10, a well-defined pit lacking burned rock.

Group III assemblages are not additive in that the variety/density relationships for each cluster are not strongly positive. Lack of an additive relationship -- one that suggests continual buildup of debris from residential or composite use histories -- could be explained by processes which with continual reuse of locations serve to reduce assemblage variety. These include tool recycling through further reduction of previously deposited artifacts or simply removal of previously deposited tools. In addition, the use histories of Cluster 3 assemblages may be attributed at least in part to Formative period occupations, since Formative period ceramics are abundant at Cluster 3 features and more abundant at features in general than at places lacking features. Lack of additive assemblages in this group coupled with evidence for use of features by groups which may have been sedentary during several seasons suggests focused reuse of Group III facilities.

Group IV

Assemblages in Group IV include those in Clusters 9 and 10 (Table 9.17). Assemblages in these clusters are similar in that they include little FAR and no ceramics. Cluster 9 lithic assemblages include high frequencies of flakes classed as produced through biface reduction and are also each distinguished by the presence of single complete hammerstones. Cluster 10 assemblages each contain a complete mano, relatively high frequencies of undifferentiated and utilized flakes, and groundstone fragments, a large proportion of which are fire-altered.

Tested features are relatively large, all but one greater than 1 meter in maximum dimension. Excavated features include: (1) Unit 45SW - Feature 3, a shallow saucer-shaped pit. This feature could be classed as a pit structure, since it is shallow enough not to have been a storage feature and lack associated FAR.; (2) In the vicinity of Feature 3 is Unit 45SW - Feature 4, a large surface of ash-stained soil lacking any depth which contains smaller deposits of more darkly stained soil; and (3) Unit 75- Feature 5 is a well-defined pitstructure with two extramural hearths.

Although occupational histories of assemblages in this group may be similar to those of assemblages in Group I, no variety/density correlations were attempted with the few cases in each cluster. Given the presence of pit structures and lack of abundant FAR, it is likely, however that assemblages are additive similar to those in Group I. The flake and groundstone fragment frequencies in this group are close to those in assemblages in Cluster 8 interpreted as containing additive assemblages.

Group V

Group V consists of a single outlying cluster which includes only one assemblage. The ceramics include only Unspecific El Paso Brownware sherds most coded in the field as bowls but some also designated as jar sherds. Since no rim sherds were present in the assemblage, it is not possible to reliably conclude that either one or two different vessels forms are represented at this feature. The lithic assemblage at this feature includes a single piece of angular debris and one formal tool, a Biface 3. The surface manifestation of this feature is a shallow lens of ash less than a centimeter thick littered with carbonate FAR.

It seems likely that this feature is the remnant of a hearth or pit which incorporated caliche as hearth rock. The fact that the distinctive chipped stone inventory is associated with an equally distinctive ceramic assemblage may be noteworthy. However, without a redundant number of cases that contain only formal tools and debris it is not really possible to offer an interpretation of the use history of this feature.

COMPARISON OF SURFACE AND SUBSURFACE ARTIFACT ASSEMBLAGES FOR SELECT FEATURES

Of the 28 features excavated, surface and subsurface artifact assemblages associated with six of them are large enough to permit comparison between the two. Table 9.18 summarizes for each of these six features the distribution of artifacts among the gross artifact classes of chipped stone flakes, chipped stone angular debris, other chipped stone (including cores and tools), ceramics, identified groundstone, and fragmented or otherwise unidentifiable groundstone. Also presented here is a summary of the distribution of these artifacts among size classes as determined by artifact length (in the case of complete flakes), maximum sherd dimension, or a size class coded in the field (primarily for chipped stone debris, cores, and groundstone).

For each feature, Table 9.18 gives the type and size summaries for surface, subsurface, and a combination of surface and subsurface assemblages. Information about the surface assemblage associated with each of these features was obtained by extrapolating the coordinates of the corners of the excavation grid system from the coordinates of center the feature (recorded by the Phase II survey) and the dimensions of the excavation grid. Artifacts inside these coordinates were then extracted from the Phase II data base. The assemblage obtained through excavation included the Phase II surface artifacts as well. Thus, the subsurface assemblage was obtained by subtracting that of the surface from that obtained through excavation. In the cases of the large excavation grids, the orientation of the surface coordinate system and the excavation grid system did not exactly correspond. Therefore, as can be seen for some of the summaries of the Inferred Subsurface assemblages, negative numbers may have been obtained because items found on the surface may not have been recovered through excavation. Another more likely reason for these discrepancies relates to the same item being measured and classified differently by the Phase II and excavation analysts. For example, a groundstone fragment coded as unidentifiable during survey may have been coded as a particular type of artifact fragment by the excavation analyst.

As can be seen in Table 9.18, the size distribution of the surface assemblage contains relatively fewer small items while small items often predominate in the subsurface assemblages.

Whereas surface assemblages are made up of 27 percent to 83 percent small items, subsurface assemblages are made up of 86 percent to 100 percent small items. This tendency is not unexpected; Wandsnider (n.d.a, n.d.b) found in the course of monitoring her experimental assemblage of artifacts through time in a field situation that smaller artifacts became buried with the influx of small amounts of sediment. This amount of sediment was insufficient to bury larger artifacts. The more accumulated sediment, the larger the size threshold of artifact visibility.

This size effect (Baker 1978) has ramifications for proportions of types of artifacts found in surface and subsurface assemblages. More flakes are small in size than, for example, other types of chipped stone. Thus, subsurface assemblages always have proportionally higher amounts of chipped stone flakes than surface assemblages.

Table 9.18. Summary of surface and subsurface artifact assemblages by artifact size and type for select features. Inferred subsurface assemblage is obtained by subtracting surface assemblage (documented through the Phase II survey) from the excavated assemblage which also included surface artifacts.

FEATURE 45SE-2: ARTIFACT LENGTH (mm)

ARTIFACT	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
CLASS	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%	0-30	30-60	>60	Total	%
Flakes	7	1	0	8	53.3	65	2	1	68	78.2	58	1	1	60	83.3
Angular Debris	2	1	1	4	26.7	14	3	0	17	19.5	12	2	-1	13	18.1
Other Lithic	0	1	0	1	6.7	0	0	0	0	0.0	0	-1	0	1	-1.4
IDed GS	0	2	0	2	13.3	0	0	0	0	0.0	0	-2	0	-2	-2.8
GS Fragments	0	0	0	0	0.0	2	0	0	2	2.3	2	0	0	2	2.8
TOTAL	9	5	1	15		81	5	1	87		72	0	0	72	
	60.0	33.3	6.7			93.1	5.8	1.1			100.0	0.0	0.0		

FEATURE 45SE-3, 7, 15 ARTIFACT LENGTH (mm)

ARTIFACT	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
CLASS	0-30	30-60	>60	Total	%	0-30	30-60	>60	Total	%	0-30	30-60	>60	Total	%
Flakes	24	3	0	27	55.1	126	7	0	133	73.5	102	4	0	106	80.3
Angular Debris	5	3	0	8	16.3	21	4	0	25	13.8	16	1	0	17	12.9
Other Lithic	3	2	0	5	10.2	2	0	2	4	2.2	-1	-2	2	-1	-0.8
IDed GS	0	2	3	5	10.2	0	1	4	5	2.8	0	-1	1	0	0.0
GS Fragments	3	1	0	4	8.2	3	8	3	14	7.7	0	7	3	10	7.8
TOTAL	35	11	3	49		152	20	9	181		117	9	6	132	
	71.4	22.5	6.1			84.0	11.0	5.0			88.6	6.8	4.5		

FEATURE 45SE-8 ARTIFACT LENGTH (mm)

ARTIFACT	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
CLASS	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%
Flakes	6	0	0	6	50.0	32	1	0	33	67.4	26	1	0	27	73.0
Angular Debris	3	1	0	4	33.3	10	2	0	12	24.5	7	1	0	8	21.6
IDed GS	0	0	0	0	0.0	0	0	1	1	6.1	0	0	1	1	2.7
GS Fragments	1	1	0	2	16.7	1	2	0	3	2.0	0	1	0	1	2.7
TOTAL	10	2	0	12		43	5	1	49		33	3	1	37	
	83.3	16.7	0.0			87.8	10.2	2.0			89.2	8.1	2.7		

able 9.18. Summary of surface and subsurface artifact assemblages by artifact size and type for select features. Inferred subsurface assemblage is obtained by subtracting surface assemblage (documented through the Phase II survey) from the excavated assemblage which also included surface artifacts.

FEATURE 48NW-2, 3 ARTIFACT LENGTH (mm)

ARTIFACT CLASS	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%
Flakes	0	1	0	1	7.1	13	2	0	15	27.8	13	1	0	14	33.3
Angular Debris	0	0	0	0	0.0	1	0	0	1	1.9	1	0	0	1	2.3
Other Lithic	0	0	1	1	7.1	1	0	0	1	1.9	1	0	-1	0	0.0
Ceramics	4	5	0	9	64.3	23	7	0	30	51.9	19	2	0	21	50.0
GS Fragments	0	2	1	3	21.4	5	4	0	9	16.7	5	2	-1	6	14.3
TOTAL	4	8	2	14		43	13	0	56		39	5	-2	42	
	28.6	57.1	14.3			76.8	23.3	0.0			92.9	11.9	-4.8		

FEATURE 48SW-1, 3, 4 ARTIFACT LENGTH (mm)

ARTIFACT CLASS	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%	0-30	30-60	> 60	Total	%
Flakes	12	2	0	14	15.7	99	3	0	102	33.7	87	1	0	88	41.1
Angular Debris	1	11	0	12	13.5	21	4	1	26	8.0	20	-7	1	14	6.5
Other Lithic	0	2	0	2	2.3	0	3	0	3	1.0	0	1	0	1	0.5
Ceramics	41	11	1	53	59.6	118	35	1	154	50.8	77	24	0	101	47.2
IDed GS	0	1	2	3	3.4	0	1	3	4	1.3	0	0	1	1	0.5
GS Fragments	0	4	1	5	5.6	2	9	3	14	4.6	2	5	2	9	4.2
TOTAL	54	31	4	89		240	55	8	303		186	24	4	214	
	60.7	34.8	4.4			79.2	18.1	2.6			86.9	11.2	1.9		

FEATURE 75-5 ARTIFACT LENGTH (mm)

ARTIFACT CLASS	SURFACE					EXCAVATED + SURFACE					INFERRED SUBSURFACE				
	0-30	30-60	> 60	Total	%	0-30	30-60	>60	Total	%	0-30	30-60	>60	Total	%
Flakes	2	1	0	3	27.3	44	2	0	46	69.7	42	1	0	43	78.2
Angular Debris	0	1	0	1	9.1	11	0	1	12	18.2	11	-1	1	11	20.0
Other Lithic	0	1	2	3	27.3	0	1	0	1	1.5	0	0	-2	-2	-3.6
IDed GS	1	0	1	2	18.2	0	1	0	1	1.5	-1	1	-1	-1	-1.8
GS Fragments	0	0	2	2	18.2	0	4	2	6	9.1	0	4	0	4	7.3
TOTAL	3	3	5	11		55	8	3	66		52	5	-3	54	
	27.3	27.3	45.5			83.3	12.1	4.5			94.5	9.1	-3.6		

The distributions of artifact size, and hence artifact type, in surface and subsurface assemblages, and the disjuncture or agreement between the two will be related to the amount of scouring by the wind experienced by that surface. The degree of exposure of the surfaces associated with the excavated features to the wind can be ranked. Units 48 and 75 are relatively flat while Unit 45 manifests a small amount of relief with a dune covered knoll in its southeastern quadrant. Unit 48 is populated by lower-relief yucca-anchored dunes, while Units 45 and 75 host higher-relief mesquite-anchored dunes. The situation of the Unit 45SE features included in this analysis on the top of and near the western edge of the only topographic high in the unit may mean that the surfaces associated with these features are a bit more scoured by southwesterly winds. The amount of scouring experienced by interdunal surfaces in Units 48 and 75 is more related to the proximity of, height of, and presence/absence of foliage on nearby dunes rather than to exposure.

Table 9.19 summarizes Kolmogorov-Smirnov tests comparing the size and artifact type distributions between surface and subsurface assemblages associated with each feature. Features 48NW-2,3, 48SW-1,3,4, and 75-5 show a significant difference in how items are distributed among size classes in surface and subsurface assemblages at the 0.01 level. At alpha=0.05, there is also a significant difference in the size distributions between feature 45SE-2 surface and subsurface assemblages. Given the more exposed situation of the Unit 45 features, it is not unexpected that there is less difference, with respect to artifact size, between the surface and subsurface assemblages for Unit 45 features that for those of Unit 48 and Unit 75.

As noted above, when proportions of artifact types are compared between surface and subsurface assemblages, there is in general a somewhat equitable distribution of items among classes in the surface assemblage and an invariably higher proportion of chipped stone flakes in the subsurface assemblage. This difference in artifact distribution is significant, however, only for Features 45SE-3, 7, 15, and 75-5 at the 0.05 level and for Feature 48SW-1, 3, 4 at the 0.01 level. In general, the absence or presence of a significant difference is related to the size of the assemblages considered. The total assemblage size of Feature 45SE-3, 7, 15 is 181 while that for Feature 48SW-1, 3, 4 is 303. All others are less than 100. It is therefore interesting that there seems to be a significant difference in the artifact type distributions between Feature 75-5 surface and subsurface distributions, since the total assemblage size considered here is only 66. It is possible that for Feature 75-5 we are observing the effects relatively more burial associated with mesquite-dune interdunal areas versus relatively lesser amounts of artifact burial in yucca-dune interdunal areas. Similar comparisons between the assemblages from subsequent feature excavations and their associated surfaces may further inform on this tendency.

Table 9.19. Summary of Kolmogorov-Smirnov tests comparing surface and subsurface assemblages for select features with respect to artifact size and artifact type as presented in previous tables.

	CRTICIAL D		OBSERVED D	
FEATURE	alpha= 0.05	alpha= 0.01	Size	Type
45SE2	0.39	0.46	0.40*	0.30
45SE-3,7,15	0.23	0.27	0.17	0.25*
45SE-8	0.45	0.54	0.05	0.17
48NW-2,3	0.42	0.50	0.64#	0.29
48SW-1,3,4	0.17	0.21	0.26#	0.25#
75-5	0.45	0.54	0.67#	0.51*

NOTES: * significant difference (at alpha=0.05) in distribution of size or type between excavated and surface assemblages.

# significant difference (at alpha=0.01) in distribution of size or type between excavated and surface assemblages.

CHAPTER 10

CONCLUSIONS: AN APPROACH TO NON-EPISODIC INTERPRETATIONS OF THE CONTINUOUS ARCHAEOLOGICAL RECORD

This study contrasts with conventional cultural resource management (CRM) reportage in several ways. First, interpreting the specific functions and periods of occupation of individual locations is not directly addressed. This is because of a basic assumption that the archaeological surfaces documented on the West Mesa are composites of debris deposited over the long-term prehistoric occupation of the region. Nevertheless, patterns of artifact discard and their interrelationships with natural depositional and post-depositional processes are evident in the archaeological record documented for the West Mesa. A second way in which this report differs from conventional studies is in its attempt to demonstrate these relationships in order to understand how the long-term use of landscapes may have varied among locations. Knowledge of variation in landscape use, or the occupational histories of places, is fundamental for ascertaining which systems and components of systems may have mapped themselves onto the archaeological landscape. The distributional methods outlined here and the results of the distributional survey and excavation have attempted to contribute to such an understanding.

Archaeological investigations carried out for the Navajo-Hopi Land Exchange Project (NHLEP) in New Mexico have examined mesa top surfaces which contain ubiquitous scatters of prehistoric cultural materials. These scatters include chipped stone and groundstone artifacts, ceramics, and burned rock concentrations sometimes associated with buried structures. Although variable in density, artifacts and features appear to be continuously distributed over the entire mesa surface, except where concealed by recent aeolian deposits. Collectively, these archaeological materials can yield information important to understanding prehistoric adaptations to the El Paso region. Mesa top surfaces, because of their potential for contributing to a scientific understanding of the prehistory of this region, qualify for inclusion in the National Register of Historic Places (Criterion D).

It is important to recognize that low density portions of the mesa top artifact distribution, as well as high density portions, will yield analytically valuable information, since both manifest aspects of the prehistoric systems which have utilized that landscape. Low density portions of the distribution may lend themselves to more direct analyses of behavioral strategies but both low and high density surface distributions offer the opportunity for study of debris composites which have accumulated over long time spans.

The Phase I inventory strategy sought to identify high density artifact distributions, particularly those yielding evidence of associated structures, for which adverse impacts resulting from the transfer of properties out of public ownership could not be satisfactorily mitigated by the Phase II data collection measures described here. These areas were initially recommended for exclusion from the land exchange but were subsequently retained in the exchange and land patent restrictions applied so that cultural resources in identified parcels could be managed and conserved until appropriate mitigation procedures are implemented.

The Phase I survey inventory also identified parcels of low to moderate artifact density in all portions of the land exchange with extremely low densities of prehistoric materials in areas below the mesa scarp. Highest densities of prehistoric materials were located in Survey Areas 1 and 2, and evidence in the form of adobe wall alignments and ashy middens uncovered during evaluation of subsurface remains has linked high density parcels with the presence of prehistoric structures in some areas.

The deflation of artifacts onto a basement paleosol dotted with sand dunes is a phenomenon characterizing the entire mesa surface. While environmental variability is low on the mesa top, however, within the region of the lower Rio Grande Valley the West Mesa provides a stark environmental contrast to the river floodplain and the Franklin Mountains to the east. The specific location of the study area on the West Mesa where the distance from the mesa scarp to the river edge is one of the least within the entire Mesilla Valley and where the floodplain is

378

pinched by the southern Franklins on the east and the Sierra Juarez to form El Paso del Norte on the west make the cultural resources in this area especially important for several reasons. First, because of general topographic and vegetational differences with other zones, this area is likely to contain subsistence resources which attracted portions of Paleoindian, Archaic, and Formative period subsistence-settlement systems not represented elsewhere in the region. Second, the unique geographical configuration in this portion of the Rio Grande Valley ensures a set of circumstances for the location of prehistoric settlements that were unique as well. In addition, without understanding the kinds of activities, occupations, and systems represented by archaeological resources within the study area, the behavioral significance of archaeological materials in riverine and mountain slope settings may remain uninterpretable.

CHAPTER SUMMARIES

A major goal of this report has been to present archaeological documentation for large continuous surfaces which contain a majority of artifactual material that is considered undiagnostic of particular archaeological cultures. Examples of the analytical utility of a distributional methodology for understanding the past use of landscape as well as the ways in which archaeological methods allow us to perceive archaeological surfaces are included in analyses of artifactual, spatial, and survey discovery data. Although a distributional data base can be approached with a great variety of analytical techniques with which to examine archaeological patterning, this report is limited, primarily due to budgetary considerations, in the scope of problems addressed. Much descriptive material is presented and basic analyses performed.

Chapter 1 provides a project overview and discusses the rationale for distributional survey which is believed to be a minimum requirement for beginning to understand interrelationships between archaeological materials in a continuous distribution. Since artifact and feature distributions outside of the high density parcels identified during the Phase I survey are perceived to have resulted from patterned use of the mesa top landscape, those that are fully exposed can be viewed as representing materials which may be partially buried by sheet sands or by dunes. Surface documentation of these distributions in conjunction with excavation of subsurface features constitute appropriate and efficient methods of data recovery for low density archaeological landscapes.

In-field analysis and mapping procedures were implemented through the Phase II distributional survey. While the spatial arrangement of materials on the archaeological surfaces examined here may lack vertical integrity, that is, while the original stratigraphic positions of artifacts may not be reconstructable, the horizontal position of artifacts and features relative to one another forms the critical basis for archaeological interpretation. Chapter 2 provides a general environmental overview, a discussion of the surface and subsurface dynamics of the study area, and the time scales of archaeological and natural deposition with respect to the horizontal integrity of artifact distributions.

Cultural historical summaries of the Paleoindian, Archaic, and Formative periods in the El Paso area have been presented and summarized in Chapter 3. Early archaeological investigations in south-central New Mexico and recent CRM projects were reviewed for models formulated to describe the general prehistoric adaptations to the El Paso area. The ways in which the study area archaeological resources could contribute to an understanding of past behavior were also addressed with an examination of pertinent ethnographic literature.

As reviewed in Chapter 4, when one moves westward approximately 2 miles from the Rio Grande scarp, previously recorded sites appear to be quite redundant in size and content. With few exceptions, the longest dimension of sites rarely exceeds 100 meters, previously recorded sites consisting of a combination of fire-cracked rock scatters, brownware ceramics, mano and metate fragments, and chipped stone debris. This lack of variability has been attributed in part to unstandardized methods for recording cultural resources and to the absence of systematic data collection strategies which would link project methodologies through a regional research design. Unstandardized recording techniques coupled with the fact that a continuous scatter of cultural materials in varying densities covers much of the inner desert basins of south-central New Mexico ensures that variability in surface distribution content, if it is encountered, may go largely unrecognized. Chapter 4 describes the systematic recording procedures used to document archaeological surfaces in Phases I and II of the survey. Phase I survey results are examined through an analyses of the artifact content of large survey parcels and these results are compared to the archaeological inventory of surface material gained through the intensive Phase II survey and to a previously conducted conventional archaeological site survey.

The wide range of topographic settings, scatter size, and types of associated artifacts at surface scatters attributed to the Archaic period in south-central New Mexico are interpreted as representing highly mobile hunter-gatherers. Opportunistic foraging for plants and gathering of target seed resources are seen as key characteristics of the subsistence system. Archaic period houses at the nearby Keystone Dam Site have been interpreted as evidence for the use and reoccupation of winter pithouses (residential bases) and for plant food storage (O'Laughlin 1980). While mountain peripheries have been modeled as containing winter residential bases, desert basins are viewed as seasonal plant gathering locales (Hard 1983).

Formative period occupations (A.D. 1 to 1400) have been described with a three phase sequence, the Mesilla Phase (A.D. 1-1100), Dona Ana Phase (A.D. 1100-1200) and the El Paso Phase (A.D. 1200-1400), which parallels a perceived transition from pithouses to above-ground masonry structures as the principal domiciliary structures. Recent excavations at Keystone Dam Site 37 (Carmichael 1985) and at the Dona Ana County Airport (Batcho et al. 1985) have demonstrated the use of pithouses into the period spanning the El Paso Phase, calling into question a clear-cut shift through time in the use of different types of structures. Traditionally, this shift has been viewed as representing an evolution toward complex agricultural systems within the region. However, the findings of recent excavations when coupled with an examination of ethnographic patterns of land use in desert basins, point to the existence of contemporaneous seasonally mobile and permanently settled adaptations, as well as to the cyclical adoption of seasonally mobile or permanent sedentary adaptations by the same groups of peoples.

Shifting patterns of land use and the systematic and repeated use of places by mobile systems and components of mobile systems will ensure that over the long-term, archaeological distributions identified by field survey are the accumulations of debris deposited during numerous events and occupations. Thus, questions concerned primarily with the nature of past adaptations, that is directly with the behavior of systems themselves, cannot be addressed without a consideration of the effects of behavioral and post-depositional processes which serve to remove archaeological distributions from the level of single events and occupations. These processes as summarized by Ebert (1986) include:

1. The processes related to the organization of human systems, particularly mobility and the activities responsible for mobility;

2. The behavioral processes of discard, loss, and abandonment that produce the material consequences of activities, creating a record primarily from discard rather than from the sum of all human activities in any simple way;

3. The processes by which discard and deposition interact with one another to form the archaeological record. Separated by phase or tempo differences, these processes result in the overlap of the products of discard through time within depositional units or strata, causing the archaeological record to differ from behavioral (discard) events in the time scale of its representation; and

4. Post-depositional natural and cultural processes which affect the preservation, integrity, and visibility of the archaeological record.

Answering questions concerned directly with behavior first necessitates "middle range" levels of inquiry into the above processes which contribute to the formation of the archaeological record. Understanding places as parts of past behavioral systems requires then, first carefully and completely recognizing, measuring, analyzing, and dissecting the patterning inherent in the archaeological record at one place (Ebert 1986). It also requires a self-conscious assessment of the techniques and procedures by which archaeological investigations are carried out. Chapter 5 presents an in-depth study of the variables affecting the quality of data recovered during archaeological survey and an assessment of the consistency with which artifact attributes were recorded.

Chapters 6 and 7 are essentially descriptive. Chapter 6 describes the attributes of the West Mesa lithics assemblage and provides several studies of the variability in artifact material type, tool and debris attributes, and patterns of groundstone use-wear and recycling. Chapter 7 details procedures for analyzing the ceramic data and presents a summary of inventoried ceramic types and attributes of vessel form.

A spatial analysis of the distributional data base presented in Chapter 8 seeks to demonstrate similarities in the spatial structure of surface distributions by identifying relationships between tool and debris classes within survey units. Spatial relationships among artifact classes were attributed to the size-sorting action of aeolian processes and to the interaction of natural post-depositional processes with the behavioral processes of discard and recycling. A differentially visible archaeological record subject to prehistoric artifact reuse and recycling was interpreted as resulting from natural depositional and post-depositional processes.

Artifact associations grouped on the basis of lithic attributes also served as the basis for interpreting the use histories of locations. Analysis of the lithic contents of spatial groupings of artifacts modeled two occupational histories. Some lithic assemblages were modeled as additive and resulting from the incremental buildup of debris discarded during relatively long-term occupations or the reuse of places for multiple functions. Additive assemblages were contrasted with those interpreted as subtractive. Increased densities of recycled groundstone were used as evidence of systematic and intensive, and possibly functionally specific, reuse of locations during which items were removed from locations on a regular basis as well as previously discarded tools recycled.

Not only is the surface distribution of artifacts and features continuous across the study area, but the subsurface distribution of features and structure appears to be continuous in many areas as well. Chapter 9 describes feature assemblages grouped on the basis of lithic content which demonstrate a good degree of consistency in the type of assemblages associated with pit structures and larger tested features. The range of radiocarbon dates obtained with charcoal samples from pit structures indicates an extremely long time span during which the West Mesa was used for seasonal habitation. Pit structures are comparable to, although smaller than, those excavated by O'Laughlin (1980) at Keystone Dam and contain few internal features.

Although a considerable number of surface features recorded represent the highly eroded remnants of hearths, pits, and structures, some features have probably been only recently exposed and remain remarkably well-preserved. These include pit structures dating to between 2500 B.C. and about A.D. 1050.

Analysis of feature assemblages indicated patterns of assemblage content similar to those described above for spatial groupings of artifacts. Importantly, patterns of assemblage content at features are associated with the use of different kinds of features and structures. Additive assemblages appear to be associated with residential pit structures. Discard processes at residences as well as the reuse of residential areas were modeled as contributing to the additive character of assemblages. Other additive assemblages appear to be associated with complexes of features that are non-residential and have been interpreted as resulting from the repetitive use of facilities. A third set of feature assemblages are not additive but appear to be the result of intensive reuse and recycling of previously discarded artifacts.

To more fully understand differences, if any, and similarities between archaeological cultures in the region, a consideration of the complexities introduced into the archaeological record by widespread recycling of discarded lithic materials is necessary. The term recycling denotes a general process by which previously discarded materials are again appropriated for use. Materials retrieved from an archaeological context to function in a systemic context are said to have been scavenged (Schiffer 1976:34) rather than recycled wholly within systemic context. Viewing scavenging from another perspective, archaeological deposits can operate as repositories from which expediently useful materials can be retrieved (Deal 1985:271; Newell 1987:147) and, thus essentially remain in systemic context. The term recycling will be used interchangeably with the term scavenging here to refer to reuse of discarded items regardless of their context.

Scavenging has been observed as a common practice among a number of groups (Ascher 1968:50-51; Binford 1979:266; Janes 1893:26), and the recycling of discarded lithic materials has been recognized as widespread among the prehistoric inhabitants of different regions (see Collins 1975:19; Gould et al. 1971:163). The recycling of lithic materials at revisited or long-term occupation sites has also been acknowledged as a determinant of assemblage content in some studies (Hofman and Morrow 1984:176-177; Simms 1983; Sullivan and Rozen 1985:773). However, recycling has yet to be considered as an important and ubiquitous process contributing to the formation of the archaeological record within a region (see Wandsnider 1987). Also examined is correspondences between the material type composition of assemblages within one region in south-central New Mexico and models of raw material selection in light of pervasive recycling of discarded lithic artifacts.

The distributional data base on which the above analyses are based is on file in computerized form with the Bureau of Land Managment, Las Cruces District Office. The reader is referred to an ancillary report of the project, "Genesis, Structure and Contents of the Navajo-Hopi Archaeological Data Base" by Luann Wandsnider, also on file with the Las Cruces District Office.

APPENDICES

APPENDIX A GEOMORPHOLOGICAL STRATIFICATION by Fred Nials

APPENDIX A

GEOMORPHOLOGICAL STRATIFICATION

ENVIRONMENTAL ZONES-- SANTA TERESA EXCHANGE AREA

I. MESQUITE COPPICE ZONE

   A. Pleistocene-floored Blowouts
   B. Partial Sand Sheet Cover
   C. Relict Large-scale Deflation Basins

II. INACTIVE SAND SHEET ZONE

III. YUCCA DUNES ZONE

   A. Yardang Area
   B. Low-relief Dunes
   C. High-relief Dunes
   D. Yucca Coppice Dunes

Note: This stratification is based solely on preliminary photo interpretation with no ground truthing.

* * * * *

ZONE, SUBZONE DESCRIPTIONS

Zone, subzone - Mesquite Coppice Zone, Pleistocene-floored blowouts (1a).

Identifying characteristic(s) - Blowouts at a uniform level, all floored by Pleistocene lag gravels, soil or Pleistocene/Holocene composite soil; some lag concentrate almost always present in floors of blowouts, mesquite-anchored coppice accumulations of modern origin.

Dominant or diagnostic vegetation - Mesquite

Modern sand cover - 25% - 60%

Present local relief - 2m - 5m

Dominant landform(s) - Mesquite-anchored coppice accumulations

Substrate (soil, gravel, etc.) - Non-coppice areas are Pleistocene sediments, Pleistocene soil, Pleistocene/Holocene composite soil, indurated caliche locally present in vicinity of major depressions, lag concentrates typically contain indurated caliche pebbles.

Sand activity, (stability, supply) - Relatively limited sand supply, coppice accumulations are modern and temporary.

Soil stratigraphy - Multiple buried soils are probably not present in this area. Pleistocene or Pleistocene/Holocene soils in blowouts all formed from the same surface or have been deflated, coppice accumulations are too young to have soil development.

Prehistoric topography - All available evidence suggests that this subzone was relatively smooth, with little relief except in the area of major deflation basins.

Archaeological visibility - Any archaeological manifestations in this subzone should be highly visible, although a portion is covered by modern coppice accumulations (25% - 60%).

Potential site integrity - The potential for stratified sites and sites that have not been somewhat affected by aeolian activity is virtually nil.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - Extensive excavation should not be considered in any potential mitigation efforts. Some sand cover in the vicinity of coppice accumulations and intervening areas is thin and highly mobile. Because of the transitory nature of this sand, artifact visibility will vary markedly from season to season. Substantial inclusions of Subzone 1b my be locally present.

* * * * *

Zone, subzone - Mesquite Coppice Zone, Partial sand sheet cover (1b).

Identifying characteristic(s) - Low relief, mesquite-anchored coppice accumulations, a large portion of the areas between coppice accumulations is covered by a sand sheet approximately .5m - 1.0m in thickness. Blowouts through the sand sheet typically expose Pleistocene sediments or soil, and contain lag gravel concentrates.

Dominant or diagnostic vegetation - The dominant vegetation is a yet-unidentified upright forb averaging approximately 20-30 cm tall. Mesquite is also abundant.

Modern sand cover - 30% - 50%+.

Present local relief - 1 - 2m in most areas.

Dominant landform(s) - Partially eroded sand sheet, mesquite-anchored coppice accumulations.

Substrate (soil, gravel, etc.) - Pleistocene sediments or soil in blowouts, lag gravel concentrate, sand sheet of relatively modern age.

Sand activity (stability, supply) - Although large supplies of sand are present, the sand sheet appears to be relatively stable, consequently coppice accumulations tend to be relatively small.

Soil stratigraphy - No soil stratigraphy is present that is of utility for archaeological purposes. The sand sheet appears to be young enough to cover any but historic archaeological manifestations. Any artifacts present will be observed only in blowouts.

Prehistoric topography - All available evidence suggests that this subzone was relatively smooth, with little relief.

Archaeological visibility - Archaeological manifestations can be observed only in the blowout areas. Observed artifact densities were low.

Potential site integrity - Poor.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - Substantial inclusions of Subzone 1a and Zone 2 may be locally present. Boundaries between Subzones 1a, 1b and Zone 2 will be gradational and difficult to precisely locate in the field.

* * * * *

Zone, subzone - Mesquite Coppice Zone, Relict large-scale deflation basins (1c).

Identifying characteristic(s) - Depressions .5 km or larger in maximum dimension, with the deepest portions up to 10m lower than surrounding areas. Other characteristics similar to Subzone 1a.

Dominant or diagnostic vegetation - Mesquite, Dalea.

Modern sand cover - Similar to Subzone 1a.

Present local relief - 1 - 3m.

Dominant landform(s) - Coppice accumulations anchored by Mesquite or Dalea.

Substrate (soil, gravel, etc.) - Pleistocene sediments or soil, lag gravel concentrates, localized outcrops of indurated caliche, thin accumulations of modern sand in vicinity of some coppice accumulations.

Sand activity (stability, supply) - Available sand supply limited, coppice accumulations are mainly modern and temporary.

Soil stratigraphy - Multiple buried soils are probably not present in this Subzone. Pleistocene soil in blowouts formed on relict surface is typically deflated, coppice accumulations are too young to have soil development.

Prehistoric topography - Broad, smooth depression.

Archaeological visibility - Visibility of archaeological materials is very good except where locally covered by coppice accumulations or thin accumulations of modern sand.

Potential site integrity - Poor.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - Extensive excavation should not be considered in any potential mitigation efforts. Some sand cover in the vicinity of coppice accumulations is thin and highly mobile. Because of the transitory nature of this sand, artifact visibility will vary markedly from season to season. Substantial inclusions of Subzone 1b may be locally present.

* * * * *

Zone, Subzone - Mesquite Coppice Zone, Escarpment edge coppice dunes (1d).

Identifying characteristic(s) - Proximity to escarpment east of the study area.

Dominant or diagnostic vegetation - Mesquite, occasional Larrea.

Modern sand cover - Not known with certainty, but appears to be very high.

Present local relief - 1 - 3m.

Dominant landform(s) - Mesquite-anchored coppice accumulations.

Substrate (soil, gravel, etc.) - Not known with certainty, but appears to be lag gravel concentrate in some blowouts, and mainly modern sand accumulations in all other areas. Sediment/soil beneath the modern sand cover are highly calcareous.

Sand activity (stability, supply) - This Subzone appears to be the trailing edge of a large, active sand sheet moving across a relict Pleistocene surface in which large supplies of sand are available for transport. Most sand accumulations appear to be relatively thin, covering highly calcareous sediment/soil.

Soil stratigraphy - Not known with certainty, most exposures appear to be modern, with the exception of some blowouts which expose Pleistocene sediments or soil. There is a possibility that the "Puebloan" soil may be locally preserved.

Prehistoric topography - Not known with certainty, but probably similar to that of today.

Archaeological visibility - Not known with certainty, but probably moderate-poor.

Potential site integrity - Not known with certainty, but probably poor.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - This area needs further on-ground observation.

Zone, subzone - Inactive Sand Sheet Zone (2)

Identifying characteristic(s) - Broad expanse of smooth sand sheet, almost total absence of blowouts, coppice accumulations, other dune forms, and mesquite.

Dominant or diagnostic vegetation - The dominant vegetation is a yet-unidentified upright forb averaging approximately 20 - 30 cm tall.

Modern sand cover - Virtually total.

Present local relief - Less than 30 cm in most locations.

Dominant landform(s) - Relatively smooth sand sheet.

Substrate (soil, gravel, etc.) - Modern aeolian sand. Very occasional and localized blowouts might expose Pleistocene sediments/soil, but these probably constitute less than 2% of the entire zone.

Sand activity (stability, supply) - This sand sheet appears to be very stable at the present time.

Soil stratigraphy - Modern sand .75 - 1.0 m thick overlying Pleistocene sediments/soil.

Prehistoric topography - Appears to have been a smooth, uninterrupted surface dating to the Pleistocene.

Archaeological visibility - Virtually nonexistent.

Potential site integrity - Although some artifacts may be present beneath the sand cover, site integrity would be poor.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - I would recommend minimal expenditure of time and effort on this zone, because geological conditions virtually preclude the finding of any archaeological manifestations other than historic.

* * * * *

Zone, subzone - Yucca Dunes Zone, Yardang-linear blowout subzone (3a).

Identifying characteristic(s) - Extremely unstable character of the sand, elongate blowouts, localized small parabolic dunes, very limited mesquite, abundant yucca.

Dominant or diagnostic vegetation - Markedly dominated by yucca. Spectacle pod, Clematis(?), Baileya (spelling?).

Modern sand cover - 90%+.

Present local relief - 1 - 2 m.

Dominant landform(s) - Yardangs, other elongate blowouts, small parabolic dunes.

Substrate (soil, gravel, etc.) - Aeolian sand, occasional limited exposures of the "Puebloan" and mid-Holocene soils, very occasional and limited Pleistocene sediment/soil exposures (characterized by lag gravel concentrates) in deepest blowouts near boundaries with other zones.

Sand activity (stability, supply) - This area is extremely unstable, with large supplies of sand supplied from modern blowouts.

Soil stratigraphy - "Puebloan" soil (A-horizon only), mid-Holocene soil (color B-horizon only), Pleistocene sediments/soil locally present near boundaries with other zones.

Prehistoric topography - Dunal topography having a relief similar to that of today.

Archaeological visibility - Very poor with the exception of limited areas around the edges of some blowouts. In these localized areas post-Archaic visibility should be moderate.

Potential site integrity - The presence of soil stratigraphy indicates the possibility of location of sites retaining some site integrity.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - Observed frequency of artifacts is very low. There is some evidence of localized very high velocity winds which have moved pebbles from blowout bottoms several meters horizontally and .5 m vertically up onto modern sand deposits.

* * * * *

Zone, subzone - Yucca Dunes Zone, Low-relief dunes zone (3b).

Identifying characteristic(s) - Modern instability, roughly circular blowouts, heavily dominated by yucca.

Dominant or diagnostic vegetation - Yucca.

Modern sand cover - 90%+.

Present local relief - 2 - 3 m.

Dominant landform(s) - Roughly circular blowouts, small parabolic dune accumulations.

Substrate (soil, gravel, etc.) - Aeolian sand, rare lag gravel concentrates near boundaries with other zones.

Sand activity (stability, supply) - Very active area with large supplies of available sand, mainly supplied by local blowouts.

Soil stratigraphy - Modern sand, "Puebloan" soil (A-horizon only), (color B-horizon only), rare exposures of Pleistocene sediments/soil.

Prehistoric topography - Appears to have been very similar to that of today.

Archaeological visibility - Very poor, with the exception of very localized areas near the edges of some blowouts.

Potential site integrity - The presence of soil stratigraphy indicates the possibility of location of sites retaining some site integrity.

Basis for this evaluation - Photointerpretation.

Comments/recommendations -

* * * * *

Zone, subzone - Yucca Dunes Zone, High-relief dunes subzone (3c).

Identifying characteristic(s) - Subzone 3b characteristics draped over relict Pleistocene(?) deflation basins 10 - 15 m lower than surrounding areas.

Dominant or diagnostic vegetation - Not known with certainty, but believed similar to Subzone 3b.

Modern sand cover - Not known with certainty, but believed to be in excess of 80%.

Present local relief - 2 - 3 m, except in areas of deeper deflation basins which have relief of 10 - 15 m.

Dominant landform(s) - Relict deflation basins.

Substrate (soil, gravel, etc.) - Not known with certainty, but believed to be similar to Subzone 3b.

Sand activity (stability, supply) - Similar to Subzone 3b.

Soil stratigraphy - Not known with certainty, but believed to be similar to Subzone 3b.

Prehistoric topography - Believed to be roughly similar to that of today.

Archaeological visibility - Not known with certainty, but believed to be similar to that of Subzone 3b. Local informant reported that sites are present near the southeast portion of this subzone.

Potential site integrity - Believed to be similar to that of Subzone 3b.

Basis for this evaluation - Photointerpretation.

Comments/recommendations - On-ground observations are needed to further evaluate this subzone.

Zone, subzone - Yucca Dunes Zone, Yucca coppice dunes subzone (3d).

Identifying characteristic(s) - Not known with certainty, but appears to be the abundance of Yucca-anchored coppice accumulations.

Dominant or diagnostic vegetation - Yucca (?).

Modern sand cover - Not known with certainty, but appears to be in excess of 80%.

Present local relief - Not known with certainty, but appears to be 1-2 m.

Dominant landform(s) - Yucca-anchored coppice accumulations (?).

Substrate (soil, gravel, etc.) - Not known with certainty, but appears to be a moderately continuous sand sheet of unknown age with superposed coppice accumulations.

Sand activity (stability, supply) - Not known with certainty, but appears to be quite unstable with moderate-large supplies of available sand.

Soil stratigraphy - Not known. Probably similar to Subzones 3b, 3c.

Prehistoric topography - Not known.

Archaeological visibility - Not known. Probably poor.

Potential site integrity - Not known. May be a potential for good site integrity (?).

Basis for this evaluation - Photointerpretation.

Comments/recommendations - On-ground observations are needed to further evaluate this subzone.

APPENDIX B

PHASE I SURVEY FIELD FORMS AND PHASE II SURVEY PROCEDURES AND SURVEY FIELD FORMS

APPENDIX B

PHASE I SURVEY FIELD FORMS AND PHASE II SURVEY PROCEDURES AND SURVEY FIELD FORMS

TRANSECT TALLY SUMMARY

SAMPLE UNIT____ T.___ R.___ Sec.___ 1/4___ 1/4___ Crew Chief________________ Date_____________

Sweep	1				2				3				4			
Position	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ceramics																
Brownware																
El Paso Poly																
Chupadero B/W																
Mimbres B/W																
Other																
Sub Total																
Lithics																
Informal																
Formal																
Sub Total																
Groundstone																
Mano																
Metate																
Hammerstone																
Indet.																
Sub Total																
Features																
Isolated FCR																
FCR Scatter																
Hearth																
Ash Stain																
Sub Total																
Historic (other)																
Hole-in-top can																
Glass																
Sub Total																
Other (not historic)																
TOTAL																

SAMPLE UNIT____ NAME____________ DATE________ TRANSECT POSITION______________

TRANSECT NO.	1	2	3	4
Ceramics:				
Brownware				
El Paso Poly				
Chupadero B/W				
Mimbres B/W				
Other				
Lithics:				
Informal				
Formal				
Groundstone:				
Mano				
Metate				
Hammerstone				
Indet.				
Features:				
Isolated FCR				
FCR Scatter				
Intact Hearth				
Ash Stain				
Other (specify)				
Historic:				
Hole-in-top can				
Glass				
Other (specify)				
Other:				
Bone				
Shell				

SAMPLE UNIT SUMMARY AND EVALUATION FORM

Sample Unit No.____ Twn.___ Rng.___ Sec.___ ¼¼___ Geomorphic Zone____________

Topography____

Surface____

Vegetation____

Overall artifact/feature density on unit:____________________

Nature of observed artifact distributions (e.g., dispersed scatters, artifact/feature concentrations, etc.):____________________

Presence of intact features (e.g., midden deposits, hearths, discrete burned caliche concentrations, etc.):____________________

Variety of artifactual remains (both major categories and subsets) observed on transects:

Degree of mechanical disturbance in unit:____________________

PROCEDURES FOR PREPARING A UNIT FOR SURVEY, SURVEYING IT, CODING THE ATTRIBUTES OF LOCATED ARTIFACTS, AND MAPPING THE ARTIFACTS

This is an outline of the procedures used to prepare a unit for survey, surveying it and discovering all surface cultural remains in it, coding the attributes of the discovered artifacts and proveniencing those artifacts. The Seedskadee Report by Wandsnider and Larralde (1984) details those procedures at greater length.

Unit Preparation

Objective: find and prepare unit for survey by discovering crew by installing sweep guides.

Personnel: crew chief and two crew members.

Equipment: lathe, flagging tape, 100 meter tape, brunton compass, pin flags (of color different from that used by discovery crew), map with unit properly located.

Unit Survey and Artifact Discovery

Objective: discover all artifacts in unit using the prescribed 5 meter interval.

Personnel: one crew chief and four crew members.

Equipment: enlarged topo sheet with survey unit located and sweeps indicated, 4 aluminum extending rods (sweep guides) bearing flagging, 2000 bright orange pin flags, 5 PCB pin flag holders, clipboard with Discovery Forms.

In-field Artifact Recording

Objective: To record attributes of each artifact and feature, for use in future analyses of distribution content and structure.

Personnel: Minimum of three trained coders, including one crew chief, preferably an individual with extensive experience at artifact analysis. The number of individuals as possible should be trained to code items, in anticipation of very dense scatters.

Equipment: Legal-size clipboards; durable code sheets with lists of codes for lithics, ceramics, historic artifacts, etc., ca. 1000 pin flags of a different color than used by the discovery crew; fortran pads; indelible ink markers for numbering pin flags.

Artifact Proveniencing Procedure

Objective: to locate all discovered artifacts within a centimeter or 0.5 meter.

Personnel: one crew chief and two crew members.

Equipment: (I) Electronic Distance Measuring (EDM) Theodolite with data-logger and prism rod, set of 2-way radios, rebar, hammer, surveyor's labels (II) 3 35-meter tapes, brunton compass, pin flags.

Procedure: Two procedures have been designed for low and high artifact density areas. Procedure I discusses the point-proveniencing of artifacts using an EDM. Procedure II describes the 0.5 meter cell proveniencing of high artifact density locales within units.

JOB DESCRIPTIONS

Unit Preparation Crew - one crew chief and two crew members.

Crew Chief: the crew chief is responsible for locating a survey unit on the ground, measuring correctly the unit dimensions, placing flagged lathe at the four unit corners, and placing pin flags at 20 meter intervals along two sides of a survey unit. He/she must be able to read a USGS topo sheet, drive a truck, use a compass to sight in unit corners, and direct other crew members in the use of a tape and compass for measuring and placing of pin flags.

Crew Member: Unit Preparation Crew Members must be physically fit and able to walk at the fast pace required in the layout of unit lines. He or she must be able to use a tape and take directions from the crew chief.

Discovery Crew - one crew chief and four crew members.

Crew Chief: the crew chief is responsible for directing the discovery crew in the initial discovery of artifacts so that consistent and even survey of the unit is maintained. He/she is also responsible for filling out the Discovery Form to be completed while the unit is being surveyed. The crew chief must be physically fit and must be able to recognize an artifact, read a map, responsibly assume paperwork and direct the work of others. Additionally, the crew chief must be able to correctly and consistently code artifacts as described for members of the Attribute Coding Crew.

Crew Member: a discovery crew member is responsible for walking across a survey unit, identifying artifacts, and flagging their location. They must be able to take direction from the crew chief and fit enough to walk at least five miles per day. The ability to code artifact attributes as a member of the attribute coding crew is absolutely necessary for at least two crew members.

Attribute Coding Crew - one chief and three crew members.

Crew Chief: The crew chief must be totally familiar with artifact attributes and their coding and with the attribute coding form. He or she must be able to drive a truck, assign coding tasks to crew members, decide on the artifact proveniencing strategy (point vs. grid proveniencing), and oversee that the coding is proceeding consistently, accurately, and swiftly.

Crew Member: the crew member must be familiar with prehistoric artifacts and the coding of their attributes. He or she must be able to learn coding conventions and swiftly and consistently code artifact attributes in the field and legibly assign numbers to artifact flags. Other necessary skills include facility with tape and compass for preparing gridded areas containing high artifact densities.

Transit Crew - one crew chief and one crew member.

Crew Chief: responsible for directing the point-proveniencing of artifacts using an Electron Distance Measuring (EDM) Theodolite with data-logging device and reflecting prisms. He/she should be familiar with the operation of the EDM and its data-logger and should be familiar with the principles of surveying. Specific responsibilities include: maintaining the equipment in working order, maintaining batteries and battery packs in a ready condition, selecting one or more mapping stations in each unit, locating at least one benchmark, making accurate and precise shots to artifacts and benchmarks, correctly using the prism rod, and instructing the crew member in the use of the transit and prism. As well, the crew chief should be able to perform as a coding crew member.

Crew Member: responsible for assisting the crew chief in proveniencing artifacts primarily by positioning the prism rod at the artifact and communicating shots via radio. He or she must have good eyesight so that all pin flags within the unit are rediscovered and shot to. He/she must also be able to carry heavy loads of pin flags and must be able to perform as a member of the artifact coding crew. With instruction, he or she may also assume responsibility as instrument operator.

PROCEDURE FOR PREPARING A UNIT FOR SURVEY, SURVEYING IT, CODING THE ATTRIBUTES OF LOCATED ARTIFACTS, AND MAPPING THE ARTIFACTS

This is an outline of the procedures used to prepare a unit for survey, surveying it and discovering all surface cultural remains on it, coding the attributes of the discovered artifacts and proveniencing those artifacts. The Seedskadee Report by Wandsnider and Larralde (1984) details these procedures at greater length.

Unit Preparation

Objective: find and prepare unit for survey by discovery crew by installing sweep guides.

Personnel: crew chief and two crew members.

Equipment: lathe flagging tape, 100 meter tape, brunton compass, pin flags (of color different from that used by discovery crew), map with unit properly located.

Procedure:

1. Find in the field a corner of the unit which has been previously mapped on a USGS quad sheet.
2. Place flagged lathe at the corner.
3. Use a brunton compass to shoot one of the cardinal directions so as to have in sight a second unit corner.
4. Send out other crew members with 100 meter tape and, using previously agreed upon hand signals, direct them as they measure out 100 meters.
5. If flags are to be placed along this line, have the person at the trailing end of the tape proceed to pin flag the line at 25 meter intervals.
6. Compass person moves up 100 meters (head of tape) and backsights on corner lathe. Continue with steps 4 and 5 until 500 meters has been measured (and pinned) out. Plant flagged lathe at corner.
7. Return to first corner and continue with steps 3 through 6 on a line perpendicular (or at 90 degrees) from the first lane laid out.
8. From the newly marked corner, shoot and measure another line parallel with the very first one laid out as in steps 3-6.
9. Repeat step 8 closing the unit and making sure that opposite sides were pin flagged.
10. Prepare Unit Discovery Map (enlarged USGS) quad portion) indicating sweep location and direction.
11. Place pseudo facts in unit, 50 in each quadrant, using a "random walk."

Unit Survey and Artifact Discovery

Objective: discover all artifacts in unit using the prescribed 5 meter interval.

Personnel: one crew chief and four crew members.

Equipment: enlarged topo sheet with survey unit located and sweeps indicated, 4 aluminum extending rods (sweep guides) bearing flagging, 2000 bright orange pin flags, 5 PCB pin flag holders, clipboard with Discovery Forms.

Procedure:

1. Relocate previously prepared unit.
2. Position 2 sweep guides, one at corner and one at about midway between corners on first line (which also happens to be unit boundary).
3. Assemble crew at five meter intervals on unit boundary opposite from where the first sweep guide was placed.
4. Survey unit, marking artifacts and features with pin flags as encountered but not backtracking to look for more items on ground already covered. Crew chief keeps track of number of items found by each crew member on every sweep, and of time per sweep.

In-field Artifact Recording

Objective: to record attributes of each artifact and feature, for use in future analysis of distribution content and structure.

Personnel: minimum of three trained coders, including one crew chief, preferably an individual with extensive experience at artifact analyses. The number of individuals making up this crew is dependent on artifact density. As many qualified individuals as possible should be trained to code items, in anticipation of very dense scatters.

Equipment: legal-size clipboards, durable code sheets with lists of codes for lithics, ceramics, historic artifacts, etc.; ca. 1000 pin flags of a different color than used by the discovery crew;

fortran pads; indelible ink markers for numbering pin flags.

Procedure:

1. Crew chief plans the most efficient means of recording the unit's artifacts, based on their spatial distribution, and directs the crew's movements to ensure that all are recorded. Crew chief coordinates artifact numbers among recording crew and mapping crew members.

2. Each crew member moves from pin flag to pin flag, assigning numbers and marking them on pin flags, and completing attribute analysis for each artifact at the same time. New artifacts are marked with a different color flag, numbered, and recorded.

3. Procedure continues until all artifacts in a unit have been recorded.

4. Features are recorded on a separate feature form that includes numbered mapping shots and a description of the feature.

Artifact Proveniencing Procedure

Objective: to locate all discovered artifacts within a centimeter of 0.5 meter.

Personnel: (I) Electronic Distance Measuring (EDM) Theodolite with data-logger and prism rod, set of 2-way radios, rebar, hammer, surveyor's labels (II) 3 35-meter tapes, brunton compass, pin flags.

Procedures: Two procedures have been designed for low and high artifact density areas. Procedure I discusses the point proveniencing of artifacts using an EDM. Procedure II describes the 0.5 meter cell proveniencing of high artifact density locales within units.

I. Point Proveniencing

I.1. Proceed to unit and locate mapping station so that most or all of the unit can be easily shot (note that this does not have to be inside the unit itself). Other mapping stations can be installed if needed. In this less than ideal case, be sure to shoot to and from other mapping stations and other permanent data such as unit corners to ensure that the locations of the mapping stations are well documented.

I.2. Set up instrument and data-logger, leveling the instrument, and zeroing the azimuth and plunge. Check out the radios and batteries to be sure they are operating properly.

I.3. Decide upon mapping strategy which may entail mentally partitioning off the unit into subunits which are then mapped in turn. This is to ensure that no artifact flag is missed.

I.4. The rodman proceeds out to the artifacts. He or she positions the prism rod at the artifact and radios the flag identification number previously assigned by the coding crew. If the flag has not yet been assigned a shot number, the rodman does so at this time. At the same time, the instrument operator sights the instrument on the prism, inputs the radio flag identification number and enables the instrument so that the azimuth and plunge are recorded.

I.5. Upon a successful shot having been made, the rodman removes the pin flag (if and only if the artifact has been both mapped and described by the coding crew) and moves on to the next pin flag.

I.6. Steps I.4 and I.5 continue until all artifacts have been mapped.

I.7. Locate a nearby benchmark ad shoot it as described in step I.4.

I.8. Before leaving the unit, pull all pin flags (including unit boundary flags) and, at one of the mapping stations, install marker (surveyors label attached to rebar) describing the unit and the date mapped.

II. Grid Proveniencing

II.1. Locate concentration of artifacts judged by Attribute Coding Crew Chief to be dense enough to require gridding.

II.2. Decide relative orientation of grid and set with lathe or pin flags one corner.

II.3. Using compass and tape, measure out grid boundaries so that they assume regular lengths like 9.0 meters (not 9.23 meters).

II.4. Mark two opposite grid boundaries with pin flags at 0.5 meter intervals.

II.5. Attribute coding crew then interpolates artifact proveniencing as they code each artifact by positioning tapes according to the pin flag guides.

II.6. Dismantle grid system upon completion.

APPENDIX C

EVALUATION OF PREHISTORIC LOCI BY JOHN R. RONEY

APPENDIX C

EVALUATION OF PREHISTORIC LOCI by John R Roney

Analysis of transect tallies for 40-acre and 160-acre sample units identified some areas in which complex, long-term residential features were probably present and identified large areas in which such remains are very unlikely to occur. However, because transect surveyors focused their observations in the 2 meter wide transects, features not associated with large, dense artifact scatters could be overlooked during the transect survey. To control this possibility, crews returned to all identified artifact concentrations in moderate and high density sample units. Crews also returned to all artifact concentrations in which ash stains or other intact features had been noted.

After initial experimentation with auger testing, a subsurface testing program was established. Early during the survey phase, four small moderate density artifact scatters in Area 3 were selected for testing, Scatters 3-1, 3-3, 9-1, and 34-1. The variety of artifact classes in these scatters suggested that they may have been the loci of short-term residence which could have included simple structures. A total of 205 auger holes varying from 0.4 to 1.9 meters in depth were drilled on these four scatters in an attempt to find structural remains. An independent approach to locating subsurface remains proved to be very time consuming and produced no useful results. Meanwhile, surveyors began to find ash stain features preserved on the surface which were as substantial as those which were being sought through independent subsurface testing. Therefore, an approach which included subsurface testing and intensive evaluation of surface remains located during survey was adopted. Crews visually inspected all portions of the artifact concentrations looking for any evidence of ash stain, adobe, rock alignment, or cultural midden. Where a thin layer of windblown sand covered the surface, a trowel or flat-nosed shovel was used to expose underlying sediments. All burned rock clusters were inspected and any area of soil discoloration was exposed with a trowel or probed with a 1 inch diameter soil auger in order to define general size and shape.

This approach is considered valid in lieu of subsurface testing because of geomorphic processes which operate in this region. Aeolian deposits which overlay the Pleistocene paleosol seem to be highly mobile. Very few artifacts were found on the aeolian deposits, supporting Nials and Davis' (1986) interpretation that the dune sand is of relatively recent age and is unlikely to include undeflated prehistoric material. With only one possible exception, all prehistoric features inspected were on or were dug into the Pleistocene paleosol. Because the paleosol is widely exposed in the project area, a high proportion of the prehistoric features which survive today should also be exposed. This argument assumes that features on the paleosol will not be rapidly destroyed once they are exposed, an assumption which is supported by the number of ash stain features which were recognized. However, it must be acknowledged that numerous other features (and artifacts) are undoubtedly buried beneath the more recent aeolian deposits. Unless they are associated with dense surface scatters of artifacts, they will be virtually impossible to locate. Evaluation results are summarized in Table C-1.

Four adobe structures were located, all in Area 2. Two of these have been previously reported. Anapra Pueblo in Unit 113 has been partially excavated (Scarborough 1983; O'Laughlin 1983), and Worley Pueblo on the boundary between Units 45 and 54 has been described by Taylor (1981). A previously unreported pueblo was found in Unit 33. Adobe wall alignments are clearly visible on a 10 meter by 20 mound, accentuated by ashy fill in one room. Curiously, very few artifacts are associated with this structure. The second previously unreported adobe pueblo was found in Unit 42, where caliche mottled clay was found in association with two extremely dense, localized artifact scatters. Because theclayoccursonly in the vicinity of the dense, midden-like artifact scatters it is inferred to be melted adobe.

Twelve areas were found which combined ash stained deposits and extremely dense artifact scatters. These areas are interpreted as probable trash middens, presumably associated with structural sites. Two were located in Area 1, one in Unit 20 and the other in Unit 26. The remaining 10 probable midden areas were in Area

2. One such area in Unit 104 had been previously recorded by Taylor (1981). Taylor also reported two midden areas in the of Worley Pueblo, on the boundary between Unit 47 and another which had been partially bulldozed in Unit 29. During this project, additional areas were found in Units 20 and 51 and on the boundary of Units 37 and 38 (three separate areas) and on the boundary between Units 57 and 85. Other potential residential areas are inferred from transect artifact densities and cluster analysis (see preceding sections). Collectively, these remains appear to represent a sizable El Paso Phase occupation on the mesa top some distance from the Rio Grande floodplain.

One other feature worthy of comment is a 1.5 meter diameter "C"-shaped arrangement of unburned caliche cobbles found in Area 2, Unit 6. The age of the feature is undetermined, but it is associated with a moderate scatter of prehistoric artifacts. Other prehistoric features described during evaluation consisted of either burned rock clusters or areas of ash staining or both. Most burned rock clusters were less than 2 meters in diameter and are interpreted as hearths or small processing features. Fewer than half were associated with ash staining, a circumstance which is almost certainly due to deflation. Fewer features were found which lacked burned rock, since features without burned rock are much more difficult to discover than those which include stones. Of the 20 ash stain features which lacked burned rock, 11 were less than 2 meters in diameter and 9 were more than 2 meters in diameter. Four were of indeterminate size. The smaller ash stain features are believed to have been simple, unlined hearths. The larger features range up to 4.6 meters by 1.8 meters in size. While these may also be hearths or processing features of some sort, it is also possible that some of these features are the remains of structures used for short-term habitation. Most lack any substantial accumulation of trash which would presumably accompany extended occupation. Finally, it should be noted that most of the stains consist of slight to moderate discoloration. Intact pieces of charcoal were extremely rare in these surface features.

TABLE C.1

PHASE I EVALUATION RESULTS

Area/Unit/Number			Findings	Unit Density
I	19	1	No features.	High
	20	1	Extremely dense artifact scatter and widespread ash staining.	Moderate
	26	1	Extremely dense artifact scatter.	Very High
II	6	1	1.5 meter diameter "C" shaped, unburned rock alignment associated with light to moderate artifact scatter. One small stain with burned rock.	High
		2	No features.	
		3	No features. Some cultural materials on post-Pleistocene deposits.	
	7	1	Stain of indeterminate size with burned rock, apparently in post-Pleistocene deposits.	Moderate
		2	No features.	
		3	No features.	
		4	No features.	
	11	1	Large stain with burned rock, two burned rock concentrations which lack ash stains.	High
		2	No features.	
		3	Stain of indeterminate size without burned rock.	
		4	One burned rock cluster without ash stain.	
	12	1	Not evaluated.	Very High
		2	Not evaluated.	
		3	Not evaluated.	
	13	1	Not relocated.	High
		2	One possible ash stain without burned rock.	
		3	No features. Some material on tops and sides of dunes.	
	14	1	No features.	Moderate
		2	No features. Some cultural material on dunes.	
		3	No features.	
		4	No features.	

TABLE C-1 (continued)

PHASE I Evaluation Results

17	1	Not evaluated.	Very High
18	1	Concentration of ca. 40 pieces of burned rock (1.5 m diameter) with ash staining.	Moderate
18/25	1	No features.	Moderate
19	1	Two concentrations of burned rock which lacked ash stain.	Moderate
	2	No features.	
	3	No features.	
20	1	Amorphous midden-like stain, large stain without burned rock.	Very High
	2	Not evaluated.	
21	1	No features.	Moderate
24	1	Not evaluated.	Low
25	1	No features.	High
	2	No features.	
	3	No features.	
18/25	1	Two concentrations of burned rock lacking ash stain.	High
26	1	Two burned rock concentrations lacking ash stain. A third burned rock concentration formed a 40 cm square, also lacking any ashy deposit.	High
28	1	Evaluated west half only. No features.	High
	2	No features.	
29	1	One cultural midden, one possible midden, one small stain with burned rock.	Very High
33	1	Adobe mound with walls and ash filled room visible.	Low
37	1	A 1 m diameter burned rock concentration lacking ash stain.	Very High
37/38	1	Three midden areas. Some cultural material on dunes.	Very High
41	1	No features. Several large cobbles on dunes.	Very High
	2	No features.	
42	1	One large stain without burned rock, two small stains without burned rock, and two small stains with burned rock.	Very High
	2	Extremely dense artifact scatter and probable adobe mound.	Very High

TABLE C-1 (continued)

PHASE I Evaluation Results

44	1	No features.	High
45	1	No features.	High
	2	No features.	
	3	No features.	
46/54	1	Worley Pueblo. Adobe walls, midden, ash stains.	---
47/55	1	Worley Pueblo. Two middens.	
48	1	No features.	High
	2	One large concentration of burned rock, but no stain.	
	3	No features. Cultural material eroding from dune in area where paleosol is not apparent.	
50	1	Not evaluated.	Low
51	1	Stain ca. 1 m in diameter with burned rock.	Very High
52	1	Two small stains with burned rock, possible midden.	Very High
56	1	Seven localized concentrations of burned rock, but no ashy deposit. Area highly eroded.	Low
57	1	Possible midden and one cluster of burned rock.	Low
	2	A single concentration of burned rock lacking ash stain.	
60	1	Hearth consisting of a semicircle of burned rock enclosing an ashy deposit.	Moderate
	2	No features.	
62	1	No features.	High
	2	No features.	
63	1	Small stain with some burned rock.	Very High
	2	Possible stain without burned rock.	
64	1	No features.	Very High
	2	No features. Burned rock and ground stone on top of dune associated with pack rat nest.	
66	1	No features.	High
	2	No features.	
	3	A 1 m by 2 m mottled ash stain 10 cm deep which includes burned rock.	
	4	No features.	
67	1	Not evaluated.	Low
68	1	No features.	Moderate
69	1	No features.	Low
	2	No features.	
	3	No features.	

TABLE C-1 (continued)

PHASE I Evaluation Results

70	1	No features.	Moderate
	2	No features.	
72	1	No features.	High
	2	No features.	
	3	No features.	
75	1	One small stain with burned rock.	Moderate
	2	One possible stain with burned rock.	
	3	No features.	
76	1	No features.	High
	2	Several burned rock scatters but no ash stains.	
	3	One small stain with burned rock.	
	4	Large (3 m by 2.5 m) stain with some burned rock.	
80	1	No features.	Moderate
82	1	Not evaluated.	Low
84	1	One burned rock concentration associated with some charcoal but no stain.	Moderate
92	1	Two small ash stains, one with burned rock.	Moderate
93	1	No features	High
	2	No features.	
100	1	No features.	High
103	1	No features.	Moderate
	2	No features.	
	3	No features.	
104	1	Very localized, dense artifact scatter with one definite midden area and several other ash stained areas.	Moderate
	2	No features.	
	3	No features.	
	4	No features.	
110	1	Not evaluated.	Low
112	1	No features.	Moderate
	2	No features.	
	3	No features.	
	4	No features.	
	5	Burned rock concentration eroding from underneath dune. No charcoal or staining.	
113	1	Anapra Pueblo. Adobe walls, midden, widespread ash staining.	Very High

TABLE C-1 (continued)

PHASE I Evaluation Results

III	1	1	Not evaluated.	Moderate
	3	1	Large stain without burned rock and a burned rock cluster. Tested with 47 auger holes which yielded a few flecks of charcoal and one other small area of stain which is believed to be of natural origin.	
		2	Not evaluated.	
		3	One small stain with burned rock. 79 auger holes were drilled, 6 yielded flecks of charcoal at depths of up to 80 cm, but no concentration. Burned rock was found in one and a single flake was recovered from another.	
	9	1	Two large stains without burned rock, one 3.5 m by 2 m by 23 cm deep and the other 4 m by 2 m and ca. 20 cm deep. Also one small (.5 m diameter) concentration of ash and burned rock. 61 auger holes were drilled, only a single flake recovered.	Low
	18	1	Not evaluated.	Low
		2	Not evaluated.	
	21	1	Not evaluated.	Low
		2	Not evaluated.	
	24	1	No features.	Moderate
		2	One concentration of burned rock, but no ash stain.	
	25	1	No features.	Low
	27	1	No features.	High
	28	1	One small stain with burned rock.	Moderate
	30	1	Several large scatters (over 5 m in diameter) and several smaller scatters (less than 1 m in diameter) of burned rock, but none included ash stain.	High
		2	A tiny, amorphous stain was eroding from coppice dune. Interpreted as natural.	
		3	Large, dark stain (1.3 m by .7 m) and a smaller stain (.35 m in diameter) lacking burned rock. Both included root fragments and may be noncultural.	

TABLE C-1 (continued)

PHASE I Evaluation Results

		4	Mottled charcoal stain 1 m by 2 m in size.	
	31	1	Not evaluated.	Low
		2	Not evaluated.	
		3	Not evaluated.	
	33	1	Not evaluated.	Low
	34	1	No features. 18 auger holes	
Moderate				
			were drilled, and numerous shovel scrapes were made to expose paleosol, all with negative results.	
	36	1	Not evaluated.	Low
		2	Not evaluated.	
	40	1	Not evaluated.	Low
	41	1	Dark charcoal stain 2 m by 1.5 m associated with very light artifact scatter.	Low
	42	1	Nine small concentrations of	
Low			Low	
			burned rock, but only one exhibited faint stain, probably a remnant of leached charcoal.	
	43	1	Several burned rock scatters, no stains.	Moderate
		2	Four intact concentrations of burned rock, one with clear ash stain.	
		3	Not evaluated.	
	44	1	Not evaluated.	Low
	45	1	One .4 m diameter stain with burned rock present, another scatter of burned rock lacking stain.	Low
		2	No features.	
		3	Black stain 1.5 m in diameter lacking burned rock.	
	46	1	Two small stains, one with burned rock, the other without.	Moderate
		2	One 2 m by 1.5 m stain lacking burned rock.	
		3	A .3 m diameter dark grey brown mottled stain which included one piece of burned rock.	
	47	1	One concentration of burned rock, but no ash stain.	Moderate

431

TABLE C-1 (continued)

PHASE I Evaluation Results

48	1	Stain 4.6 by 1.8 meters in size, lacking burned rock. Associated with relatively dense artifact scatter.	High
51	1	A 1 m diameter concentration of burned rock with a brown, mottled stain.	Low
53	1	Small burned rock concentration with no stain.	Low
61	1	No features.	High
66	1	No features.	Low
67	1	Poorly defined, mottled stain 1.5 m by .7 m in size. Lacked burned rock, but included root fragments.	Low

APPENDIX D

SURVEY AREAS 1 AND 2: PARCELS UNDER PATENT RESTRICTIONS

AREA 1

UNIT 20 S1/2

20 ACRES

DESCRIPTION:

Unit 20 contains a dense scatter of ceramics along transects 3C and 3D within 50 meters of the southern unit border. An extremely dark ashy stain covers approximately a 5 meter diameter area in this area. Transects picked up higher polychrome and brownware counts here but did not encounter the densest concentration which was found during a revisit by Roney, Larralde, Camilli, and Hard.

UNIT 26

40 ACRES

DESCRIPTION:

A dense midden deposit containing lithics, ceramic, shell, and bone is located 50 meters north of the south line on transects 3A, 3B, and 3C. The density, type, and variety of remains here indicate a buried pueblo or pithouses. Roney, Larralde, Camilli, and Hard also visited this provenience and identified the remains as a midden deposit.

AREA 2

UNITS 5 AND 8

80 ACRES

DESCRIPTION:

The density of historic artifacts and artifact concentrations in these units is extremely high. The modern railroad bed and the old Southern Pacific rail grade are located in the SW1/4 of Unit 5. The remains of tent structures, can and bottle dumps, coal piles, and shop debris representing a large railroad construction camp associated with the original Southern Pacific right-of-way constructed in 1881 cover most of the unit. Other artifact concentrations in Unit 5 include a glass and can dump measuring 10 by 10 meters adjacent the old rail grade. Approximately the eastern half of Unit 8 is scattered with concentrations of bottles and hole-top cans dating from the same period that may represent the locations of individuals tents used during the occupations of the II-5-2 camp.

UNIT 6

10 ACRES

DESCRIPTION:

A dense prehistoric artifact scatter of lithics, ceramics, and fire-cracked (FCR) rock surrounds an intact feature consisting of tabular chunks of unburned limestone in a 20 by 30 meter area. The presence of ceramics and high variety of material including groundstone (see artifact tallies for transects 3B through 4A) suggest structural remains in this area.

UNIT 11 SE1/4

10 acres

DESCRIPTION:

The southeastern quarter of this unit contains a dense concentration of FCR and chipped stone and groundstone artifacts in association with a few brownware and El Paso Polychrome sherds. (Note lithic and FCR counts on transects 3C through 4A.) Artifactual material as well as a medium to dark ash stain was noted eroding out of the side of a mesquite coppice dune indicating cultural materials buried above of surrounding interdunal surface.

UNIT 12

40 ACRES

DESCRIPTION:

Three concentrations of artifactual material occur in this unit none of which were further evaluated after the Phase I survey. Survey notes and field sketch maps indicate a concentration in the southeastern corner of the unit, one about 150 meters north of the southern boundary on transect 2A and one in the southwestern corner of the unit. Transect counts on 1A-C indicate II-12-1, transects 2A-B indicate II-12-2, and 4B and 4C represent II-12-3. Provenience II-12-3 may be a continuation of II-18-1 in the unit to the south. II-18-1 includes an FCR cluster with stain interpreted as a hearth. While these counts may seem low, it should be remembered that they represent only 8 percent of the unit area. Relatively high densities are obtained when looking at counts per linear transect meter (count divided number of linear transect meters walked in the unit) in the enclosed cluster analysis results (see Cluster 3). The concentration at II-12-2 in particular merits testing due to its high densities of material.

UNIT 13

40 ACRES

DESCRIPTION:

Two proveniences containing dense concentrations of lithics, ceramics and FCR are present in this unit. II-13-2 was tested with a soil probe and found to contain a dark stain in association with lithic and ceramic debris (see transect counts 2C-3A and Cluster 3). The density of sherds may indicate a buried structure here. II-13-3 shows as only a slight increase in transect counts. It is located in the southwestern corner of the unit and may be a continuation of II-19-2.

UNIT 14

40 ACRES

DESCRIPTION:

This unit contains four proveniences. II-14-1 contains the remains of a camp probably associated with construction of the old El Paso Southwestern rail grade around 1902 as well as a sparse scatter of prehistoric material. Evaluation of II-14-2 and II-14-4 revealed low density artifact scatters and no subsurface stains. II-14-3 contains a low-moderate density lithic scatter with no associated surface features.

UNITS 17 S1/2 AND 24 N1/2

40 ACRES

DESCRIPTION:

Unit 17 contains extremely high densities of ceramics, lithic, FCR, and groundstone on transects 2A to 2C just north of the southern boundary. This area could be interpreted as a "sheet midden" (II-17-1) and is also associated with an FCR "hearth" scatter. Similar materials are contained in the N1/2 of Unit 24 (II-24-1) although densities are not quite as high. The scatter appears relatively continuous between these two units continuing south into Unit 24 along transect 2B. Unit 24 also contains a smaller scatter (II-24-2) on transects 1C and 1D about 200 meters south of its northern boundary. The extremely high variety of remains, especially ceramics, is a good indication of residential occupation at II-17-1.

UNITS 20 AND 21 W1/2 AND SE1/4 70 ACRES
UNITS 28 E1/2 AND 29 W1/2 40 ACRES

DESCRIPTION:

Unit 20 contains three areas of moderate to high artifact densities also characterized by high artifact variety. II-20-1 is located in the southwestern corner of the unit. Two stains were recorded at these proveniences, one noted as "midden-like". II-20-2 is on transect 4B-4C--according to notes it is located about midway between northern and southern boundaries, although all field maps place it closer to the southern boundary. The third area was recorded as II-21-1 and covers portions of Units 20 and 21. II-21-1 is a moderate to high density scatter dominated by lithics and FCR. This scatter is about 300 meters long and may extend into the southeastern corner of Unit 14. No stains were observed here.

The eastern half of Unit 28 and western half of Unit 29 were recorded as II-28-1 and II-29-1. This is an area of high to moderate densities of ceramics, lithics, groundstone, and FCR. Numerous stains were observed in Unit 29 in particular. The scatter continues into the lower portions of the SE1/4 of Unit 21. The potential for structural remains under mesquite coppice accumulations was assessed as high in Unit 29.

UNIT 33 NE1/4

10 ACRES

DESCRIPTION:

An ashy, potted mound dotted with small piles of artifacts at pot holes was designated II-33-1. This provenience contains an adobe structure estimated at from 1 to 4 rooms in size. Adobe wall alignments some turning at right angles were clearly seen just below the surface when scraped with a trowel. The integrity of the surface artifact distribution here has been totally destroyed. However, the potting seems to have taken place in localized pits so that the remains of the structure are probably intact. The area of the structural mound is 5 meters in diameter. It is located between transects 4B and 4C about 150 meters south of the northern unit boundary.

UNIT 37 AND 38 W1/2

60 ACRES

DESCRIPTION:

A small concentration of primarily lithic material, II-37-1, is located along transects 1B - 1C about 150 meters north of the southern boundary of Unit 37. The majority of material in these units is located between transects 4A in Unit 37 and 1C in Unit 38 along almost the entire length of these units. Artifact density is high with three areas of ash stain which may represent or be associated with structural remains. Highest densities are situated on or near low rises in the north and south on the Unit 37/38 border. The northern area contains the observed stains.

UNITS 41 AND 42

80 ACRES

DESCRIPTION:

These units encompass four proveniences. II-41-2 is located along the southern border of Unit 41. No description of it could be found but it would be extremely easy to relocated relative to unit corners. II-41-1 is an extremely high density area located on transects 4A, 4B, and 4C--highest densities were recorded about 175 meters south of the northern unit boundary. Several concentrations of cobbles were observed here. II-42-1 contains four stains which are good candidates for midden areas and processing features. II-42-2 yielded evidence of structural remains in the form of puddled adobe walls and an associated midden. Extremely high ceramic densities were recorded here. The AT&T line station 68+20 is adjacent this feature.

UNITS 46, 47, 54 AND 55

160 ACRES

DESCRIPTION:

WORLEY PUEBLO -- Vandalized adobe pueblo.
These units were not surveyed during Phase I. Unit 55 was surveyed by Taylor in 1981 and concentrations of material representing middens and structures were mapped by him in all units.

UNITS 51, 52, 63 AND 64

160 ACRES

DESCRIPTION:

Moderate to high densities of artifacts occur at II-51-1 and II-52-2. Ash stains midden-like areas and possible pot holes are located at these proveniences. Transects 2C and 2D contains material about 100 meters south of the northern boundary of Unit 51 -- this is II-51-1. II-52-2 is located along the southern border of Unit 51 beginning at transect 3B and continues into Unit 52 until transect 2A. A lower density distribution continues and covers most of the SW1/4 of Unit 52.

The high density areas in Unit 63 and 64 are situated immediately south of II-52-2 and artifact scatters are generally continuous between these areas. II-64-1 contains pockets of extremely high densities of material especially ceramics including high densities of Chihuahuan Polychromes. (See transect tallies for 1A and 1B.) II-63-1 and II-63-2 are moderate density scatters with associated stains. II-75-3 extends into the southwest corner of Unit 63. II-64-2 is a moderately dense scatter without associated staining. II-76-4 is located on the southern boundary of Unit 64 at transect 4A. The stain here interpreted as structural.

UNITS 57/58

10 ACRES

DESCRIPTION:

II-57-1 is a dense midden deposit located on the mesa top edge on the border between these two units. This area has been vandalized. The presence of midden deposits suggests an associated structure (see transect counts 1D-2C).

UNIT 72

20 ACRES

DESCRIPTION:

II-72-2 is a low density lithic/ceramic scatter. Sherds, lithics, and groundstone in a relatively dense concentration litter the area between transects 3A and 3D in NE1/4 of the unit at II-72-3. This unit was revisited by Roney, Larralde, Camilli, and Hard. No features or stains were observed at that time, but the density of material may be a clue to buried features. These two proveniences were perceived as a single distribution during the Phase I survey.

UNITS 94 SE1/4, 95 SW1/4, AND UNIT 104 N1/2

DESCRIPTION:

Units 94 and 95 were not surveyed during Phase I but are encompassed by Taylor's (1981) Quadrant 2 survey unit. Sites A-1, A-2, A-3, and A-4 were recorded here.

Three proveniences were recorded in the N1/2 of Unit 104. II-104-1 is a probable pueblo. Stains here indicate midden deposits and large rocks which may indicate wall footings. This is a moderately high density, high variety area (see transects 3A-3D--transects missed most of the midden). II-104-2 is a low density scatter without associated stain. II-104-3 was not relocated but appears to be a very low density scatter from transect counts.

UNIT 113 N1/2

DESCRIPTION:

ANAPRA PUEBLO

The site surface has been totally obliterated by front-end loader scraping of a trespass dump covering most of the eastern half of this unit. Horse manure and smoldering garbage are strewn over thousands of square meters here. Currently the road from the scarp edge to the interior mesa top runs directly on top of the pueblo. Local pothunters were observed on one occasion at the pueblo, but left when they spotted a BLM vehicle.

Several rooms of the pueblo were excavated in a systematic and professional manner by Tom O'Laughlin and Vernon Scarborough (see Scarborough 1986).

APPENDIX E
PHASE II DISCOVERY DATA

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 2SE Surveyed: JANUARY 7, 1985

Sweep Positions:

A: Jane Pike
B: Igor Steel
C: Tim Mann
D: Dave Kayser
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	12:01	12:14	0:13	3	2	3	0	1	9
2	12:17	12:27	0:10	2	0	3	2	0	7
3	12:29	12:41	0:12	0	1	0	1	3	5
4	12:43	12:54	0:11	5	1	3	1	8	18
5	12:39	13:10	0:31	7	0	4	1	4	16
6	13:12	13:21	0:09	3	0	0	2	0	5
7	13:26	13:46	0:20	3	13	26	22	6	70
8	13:49	14:02	0:13	0	1	0	5	11	17
9	14:18	14:32	0:14	4	4	4	4	3	19
10	14:36	14:50	0:14	10	3	4	4	0	21
11	14:53	15:11	0:18	5	9	10	1	1	26
12	15:19	15:30	0:11	4	5	16	14	13	52
13	8:39	8:52	0:13	18	8	2	7	4	39
14	8:53	9:02	0:09	6	13	3	2	0	24
15	9:04	9:16	0:12	3	3	6	15	11	38
16	9:20	9:31	0:11	6	12	3	1	1	23
TOTAL	12:01	9:31	3:41	79	75	87	82	66	389

Efficiency (Artifacts/Minute) = 1.76

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 2NE

Surveyed: DECEMBER 2, 1984

Sweep Positions:

A: John Stein
B: Signa Larralde
C: Tim Mann
D: Igor Steel
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	14:01	14:10	0:09	0	1	0	1	0	2
2	13:47	13:59	0:12	3	13	11	0	0	27
3	13:26	13:36	0:10	0	3	4	0	0	7
4	13:16	13:25	0:09	0	0	0	0	0	0
5	13:03	13:13	0:10	0	0	0	0	0	0
6	12:50	12:59	0:09	0	0	1	0	0	1
7	12:40	12:49	0:09	0	0	2	0	1	3
8	12:29	12:38	0:09	0	0	1	0	0	1
9	11:11	11:23	0:12	1	0	1	3	0	5
10	10:57	11:08	0:11	0	0	0	0	1	1
11	10:45	10:55	0:10	17	15	3	4	4	43
12	10:31	10:41	0:10	23	23	2	1	0	49
13	10:15	10:29	0:14	0	1	0	0	0	1
14	10:03	10:13	0:10	1	1	0	0	1	3
15	9:45	9:56	0:11	0	2	2	1	9	14
16	9:32	9:40	0:08	0	0	0	0	1	1
TOTAL	14:01	9:40	2:43	45	59	27	10	17	158

Efficiency (Artifacts/Minute) = 0.97

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 2NW Surveyed: DECEMBER 5, 1984

Sweep Positions:

A: Dave Simons
B: Signa Larralde
C: Eileen Camilli
D: Jane Pike
E: Igor Steel

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	11:59	12:06	0:07	1	2	0	0	1	4
2	11:47	11:57	0:10	0	3	0	2	0	5
3	11:35	11:45	0:10	0	4	3	2	9	18
4	11:10	11:24	0:14	0	8	29	21	4	62
5	11:00	11:09	0:09	1	0	10	0	3	14
6	10:47	10:53	0:06	2	1	0	0	0	3
7	10:39	10:46	0:07	0	0	0	0	1	1
8	10:30	10:37	0:07	3	1	0	0	0	4
9	10:03	10:10	0:07	0	0	0	0	0	0
10	9:55	10:02	0:07	0	1	0	0	0	1
11	9:44	9:50	0:06	0	0	0	0	0	0
12	9:27	9:38	0:11	0	1	0	0	0	1
13	9:19	9:26	0:07	0	2	0	0	0	2
14	9:08	9:17	0:09	0	1	0	1	0	2
15	8:47	9:05	0:18	0	0	0	0	1	1
16	8:47	8:55	0:08	0	3	0	0	0	3
TOTAL	11:59	8:55	2:23	7	27	42	26	19	121

Efficiency (Artifacts/Minute) = 0.85

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 2SW   Surveyed: JANUARY 5, 1985

Sweep Positions:

A: Igor Steel
B: Jane Pike
C: Eileen Camilli
D: Signa Larralde
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	12:48	12:56	0:08	0	0	0	0	0	0
2	13:02	13:09	0:07	0	0	5	0	0	5
3	13:11	13:20	0:09	0	5	0	0	0	5
4	13:22	13:33	0:11	0	0	0	2	0	2
5	13:35	13:45	0:10	0	1	0	0	0	1
6	13:51	13:59	0:08	1	0	0	0	0	1
7	14:01	14:09	0:08	0	13	0	0	0	13
8	14:12	14:20	0:08	2	4	6	7	0	19
9	14:25	14:33	0:08	1	0	16	5	0	22
10				24	20	16	19	15	94
11	10:30			3	5	6	7	11	32
12				1	0	5	2	3	11
13	12:15	12:20	0:05	18	25	33	3	2	81
14	12:35	12:48	0:13	0	1	7	13	4	25
15	12:55	13:07	0:12	0	0	1	0	0	1
16	13:15	13:28	0:13	0	0	1	0	0	1
TOTAL	12:48	13:28	2:00	50	74	96	58	35	176

Efficiency (Artifacts/Minute) = 2.61

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 3NW Surveyed: JANUARY 22, 1985

Sweep Positions:

A: Dave Simons
B: Tim Mann
C: Jane Pike
D: Igor Steel
E: Dave Kayser

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies					Total
				A	B	C	D	E	
1	9:50	9:58	0:08	3	0	3	2	8	16
2	9:36	9:49	0:13	3	6	6	4	8	27
3	9:23	9:34	0:11	2	14	10	11	16	53
4	9:09	9:21	0:12	17	13	20	8	16	74
5	8:57	9:08	0:11	7	1	4	3	7	22
6	15:05	15:15	0:10	14	9	6	18	10	57
7	14:55	15:04	0:09	2	6	3	3	4	18
8	14:44	14:52	0:08	5	7	5	7	19	43
9	14:26	14:41	0:15	16	22	27	18	28	111
10	14:02	14:18	0:16	16	26	13	16	29	100
11	13:44	14:00	0:16	25	24	27	33	24	133
12	13:28	13:41	0:13	4	4	12	14	18	52
13	13:10	13:26	0:16	33	34	25	12	21	125
14	12:18	12:28	0:10	5	8	4	3	6	26
15	12:06	12:16	0:10	2	0	2	3	9	16
16	11:45	12:03	0:18	10	9	22	29	29	99
TOTAL	9:50	12:03	3:16	164	183	189	184	252	972

Efficiency (Artifacts/Minute) = 4.96

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 3SE   Surveyed: JANUARY 9, 1985

Sweep Positions:

A: John Roney
B: Igor Steel
C: Tim Mann
D: Alfred Hobbs
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	14:24	14:33	0:09	1	1	0	3	2	7
2	14:36	14:46	0:10	1	13	8	5	4	31
3	14:47	15:05	0:18	8	16	19	5	5	53
4	15:09	15:22	0:13	11	7	15	8	6	47
5	8:52	9:06	0:14	7	2	4	4	8	25
6	9:09	9:27	0:18	1	8	17	11	26	63
7	9:30	9:45	0:15	7	10	20	11	7	55
8	9:47	10:07	0:20	10	12	23	28	25	98
9	10:10	10:32	0:22	36	35	16	23	31	141
10	10:40	11:03	0:23	49	47	60	40	35	231
11	11:14	11:36	0:22	38	38	38	44	30	188
12	11:38	11:50	0:12	60	79	80	60	58	337
13	12:58	13:25	0:27	57	65	66	74	43	305
14	14:26	14:44	0:18	31	34	25	26	31	147
15	14:48			24	36	36	48	46	190
16	9:11	9:19	0:08	15	14	4	5	7	45
TOTAL	14:24	9:19	4:09	356	417	431	395	364	1773

Efficiency (Artifacts/Minute) = 7.88

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 3SW Surveyed: JANUARY 8, 1985

Sweep Positions:

A: John Roney
B: Igor Steel
C: Tim Mann
D: Alfred Hobbs
E: Dave Simons

	Begin	End	Elapsed Time	Artifact Tallies					
Sweep	Time	Time	(Hrs:Mins)	A	B	C	D	E	Total
1	9:52	10:04	0:12	15	5	4	3	5	32
2	10:12	10:22	0:10	15	15	9	8	12	59
3	10:24	10:35	0:11	7	1	11	5	1	25
4	10:37	10:47	0:10	0	0	0	4	10	14
5	10:51	11:02	0:11	3	5	3	10	2	23
6	11:04	11:12	0:08	3	6	0	3	0	12
7	11:13	11:23	0:10	1	0	2	2	1	6
8	11:25	11:33	0:08	1	3	0	0	2	6
9	12:16	12:30	0:14	6	9	9	9	2	35
10	12:31	12:42	0:11	8	7	4	5	13	37
11	12:44	12:56	0:12	10	9	8	0	2	29
12	12:59	13:11	0:12	6	7	3	9	12	37
13	13:16	13:29	0:13	6	3	4	16	3	32
14	13:31	13:41	0:10	2	1	2	4	0	9
15	13:48	14:01	0:13	13	11	2	3	12	41
16	14:02	14:12	0:10	5	2	1	3	0	11
TOTAL	9:52	14:12	2:55	101	84	62	84	77	408

Efficiency (Artifacts/Minute) = 2.33

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 1 Surveyed: APRIL 11, 1985

Sweep Positions:

A: Eileen Camilli
B: Cheryl Wase
C: Kathy Niles
D: Robert Hadyen
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies					Total
				A	B	C	D	E	
1	10:27	10:42	0:15	14	17	37	9	13	90
2	10:45	10:58	0:13	11	8	30	13	23	85
3	11:00	11:14	0:14	12	17	20	28	49	126
4	11:16	11:29	0:13	16	7	17	10	27	77
5	12:09	12:23	0:14	18	15	40	20	26	119
6	12:26	12:40	0:14	17	18	27	37	47	146
7	12:44	12:58	0:14	10	11	56	52	40	169
8	13:00	13:10	0:10	2	18	6	5	9	40
9	8:21	8:36	0:15	25	10	25	116	8	184
10	8:37	8:49	0:12	12	3	7	5	17	44
11	8:53	9:05	0:12	7	12	9	20	7	55
12	9:06	9:20	0:14	12	8	23	22	38	103
13	9:22	9:32	0:10	4	1	8	6	6	25
14	9:33	9:45	0:12	5	7	1	14	39	66
15	9:50	10:00	0:10	4	5	1	1	0	11
16	10:01	10:11	0:10	2	1	6	13	2	24
TOTAL	10:27	10:11	3:22	171	158	313	371	351	1364

Efficiency (Artifacts/Minute) = 6.75

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 3 Surveyed: APRIL 4, 1985

Sweep Positions:

A: Robert Hadyen
B: Alfred Hobbs
C: Curtis Ascher
D: Igor Steel
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	8:46	8:54	0:08	0	1	0	0	0	1
2	9:00	9:12	0:12	0	5	0	1	0	6
3	9:19	9:27	0:08	0	0	0	0	0	0
4	9:29	9:42	0:13	0	1	0	3	0	4
5	9:45	9:53	0:08	1	0	0	2	0	3
6	9:55	10:02	0:07	0	0	0	0	0	0
7	10:04	10:10	0:06	0	0	0	0	0	0
8	10:12	10:19	0:07	0	0	0	0	0	0
9	10:21	10:31	0:10	3	6	3	2	1	15
10	10:33	10:42	0:09	1	0	0	0	0	1
11	11:27	11:34	0:07	0	0	0	0	0	0
12	11:36	11:44	0:08	1	1	0	0	0	2
13	11:46	11:52	0:06	0	0	0	0	0	0
14	11:54	12:03	0:09	0	0	0	1	0	1
15	12:05	12:13	0:08	0	1	0	0	1	2
16	12:16	12:24	0:08	0	1	0	0	1	2
TOTAL	8:46	12:24	2:14	6	16	3	9	3	37

Efficiency (Artifacts/Minute) = 0.28

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 16 Surveyed: APRIL 18, 1985

Sweep Positions:

A: Dave Simons
B: Curtis Ascher
C: Igor Steel
D: Alfred Hobbs
E: Kathy Niles

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
9	9:55	10:12	0:17	0	0	0	2	0	2
10	9:46	9:54	0:08	0	0	0	0	0	0
11	9:36	9:42	0:06	0	0	0	0	0	0
12	9:28	9:35	0:07	0	0	0	0	0	0
13	9:19	9:25	0:06	0	0	0	0	0	0
14	9:14	9:18	0:04	0	0	0	0	0	0
15	9:02	9:10	0:08	0	0	0	0	0	0
16	8:55	9:01	0:06	0	0	0	0	0	0
TOTAL	9:55	9:01	1:02	0	0	0	2	0	2

Efficiency (Artifacts/Minute) = 0.03

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 25 Surveyed: MARCH 28, 1985

Sweep Positions:

A: Igor Steel
B: Cheryl Wase
C: Eileen Camilli
D: Robert Hadyen
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:18	9:26	0:08	4	3	3	0	9	19
2	9:29	9:38	0:09	4	9	2	6	4	25
3	9:41	9:51	0:10	2	4	1	2	7	16
4	9:53	10:06	0:13	2	6	3	13	18	42
5	10:17	10:32	0:15	23	15	25	28	9	100
6	10:35	10:51	0:16	18	26	20	19	15	98
7	10:54	11:11	0:17	39	45	29	10	11	134
8	11:13	11:29	0:16	4	96	67	36	3	206
9	12:15	12:27	0:12	3	6	14	2	8	33
10	12:29	12:40	0:11	3	4	2	7	37	53
11	12:43	12:59	0:16	32	21	27	11	26	117
12	13:02	13:11	0:09	6	0	4	9	3	22
13	13:23	13:36	0:13	3	23	35	14	35	110
14	13:40	13:56	0:16	18	18	47	13	2	98
15	14:05	14:17	0:12	1	2	11	7	27	48
16	14:18	14:29	0:11	3	5	8	7	6	29
TOTAL	9:18	14:29	3:24	165	283	298	184	220	1150

Efficiency (Artifacts/Minute) = 5.64

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 32 Surveyed: MARCH 19, 1985

Sweep Positions:

A: Igor Steel
B: Kathy Niles
C: Signa Larralde
D: Eileen Camilli
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies					Total
				A	B	C	D	E	
1	13:26	13:33	0:07	0	2	1	5	1	9
2	13:35	13:42	0:07	0	0	1	0	1	2
3	13:46	13:55	0:09	3	2	6	2	0	13
4	13:58	14:04	0:06	2	2	1	1	22	28
5	14:07	14:14	0:07	1	1	0	2	2	6
6	14:16	14:23	0:07	3	1	0	0	1	5
7	14:25	14:33	0:08	0	4	1	4	0	9
8	14:37	14:45	0:08	9	4	0	7	2	22
9	9:25	9:33	0:08	3	6	6	5	4	24
10	9:36	9:45	0:09	6	14	3	4	2	29
11	9:52	9:59	0:07	2	0	0	2	2	6
12	10:09	10:16	0:07	1	3	6	4	4	18
13	10:19	10:27	0:08	2	5	7	3	4	21
14	10:30	10:40	0:10	4	10	4	8	8	34
15	10:43	10:52	0:09	6	11	15	12	7	51
16	10:55	11:11	0:16	11	76	49	28	5	169
TOTAL	13:26	11:11	2:13	53	141	100	87	65	446

Efficiency (Artifacts/Minute) = 3.35

42-

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 50 Surveyed: APRIL 24, 1985

Sweep Positions:

A: Eileen Camilli
B: Kathy Niles
C: Cheryl Wase
D: Curtis Ascher
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	8:35	8:42	0:07	1	1	2	0	0	4
2	8:45	8:53	0:08	1	1	0	0	1	3
3	8:55	9:05	0:10	1	2	3	6	3	15
4	9:07	9:15	0:08	7	2	3	0	2	14
5	9:20	9:29	0:09	1	4	1	2	2	10
6	9:32	9:50	0:18	7	16	16	3	24	66
7	10:31	10:43	0:12	13	15	20	5	17	70
8	10:46	11:11	0:25	37	25	36	36	25	159
9	11:17	11:37	0:20	29	38	24	19	46	156
10	11:41	12:13	0:32	37	129	127	77	93	463
11	13:00	13:17	0:17	48	63	37	15	17	180
12	13:20	13:31	0:11	16	39	18	19	10	102
13	13:35	13:45	0:10	1	9	20	11	16	57
14	13:47	13:59	0:12	3	16	23	11	5	58
15	14:13	14:23	0:10	5	2	2	8	11	28
16	14:24	14:34	0:10	9	19	5	2	1	36
TOTAL	8:35	14:34	3:39	216	381	337	214	273	1421

Efficiency (Artifacts/Minute) = 6.49

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 75 Surveyed: MARCH 31, 1985

Sweep Positions:

A: Igor Steel
B: Cheryl Wase
C: Kathy Niles
D: Robert Hadyen
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:05	9:15	0:10	8	3	13	7	1	32
2	9:21	9:29	0:08	3	4	4	5	10	26
3	9:34	9:44	0:10	4	3	10	3	8	28
4	9:47	10:00	0:13	5	13	10	15	24	67
5	10:02	10:14	0:12	30	13	12	13	10	78
6	10:17	10:30	0:13	14	28	12	20	24	98
7	10:44	11:00	0:16	52	58	30	12	8	160
8	10:05	11:20	1:15	8	22	21	24	11	86
9	12:09	12:19	0:10	13	11	16	5	14	59
10	12:21	12:39	0:18	20	52	41	54	32	199
11	12:41	12:54	0:13	4	13	16	31	34	98
12	12:58	13:13	0:15	24	19	11	16	14	84
13	13:25	13:35	0:10	3	24	35	15	16	93
14	13:38	13:48	0:10	17	12	4	14	12	59
15	13:50	13:59	0:09	8	7	13	10	7	45
16	14:02	14:14	0:12	4	14	14	26	18	76
TOTAL	9:05	14:14	4:14	217	296	262	270	243	1288

Efficiency (Artifacts/Minute) = 5.07

42

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 110 Surveyed: MARCH 21, 1985

Sweep Positions:

A: Igor Steel
B: Kathy Niles
C: Alfred Hobbs
D: Eileen Camilli
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	10:21	10:31	0:10	5	16	11	5	4	41
2	10:33	10:43	0:10	14	21	8	1	2	46
3	10:44	10:53	0:09	1	12	10	1	5	29
4	10:54	11:01	0:07	5	1	5	4	2	17
5	11:03	11:10	0:07	6	10	20	7	4	47
6	11:13	11:20	0:07	3	1	2	3	1	10
7	11:22	11:31	0:09	2	14	6	4	6	32
8	11:33	11:42	0:09	12	5	29	14	12	72
9	11:43	12:44	1:01	13	19	12	8	8	60
10	12:46	12:58	0:12	26	33	30	28	11	128
11	12:59	13:08	0:09	13	17	4	2	23	59
12	13:10	13:18	0:08	3	8	1	8	1	21
13	13:20	13:29	0:09	6	3	9	1	1	20
14	13:30	13:51	0:21	1	2	1	10	1	15
15	13:53	14:03	0:10	3	10	7	4	4	28
16	14:08	14:16	0:08	1	1	10	9	2	23
TOTAL	10:21	14:16	3:26	114	173	165	109	87	648

Efficiency (Artifacts/Minute) = 3.15

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 21SW Surveyed: FEBRUARY 15, 1985

Sweep Positions:

A: Dave Kayser
B: Igor Steel
C: John Roney
D: Tim Mann
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	8:45	8:52	0:07	1	0	0	2	4	7
2	8:54	9:00	0:06	2	0	0	0	0	2
3	9:01	9:07	0:06	1	0	1	2	2	6
4	9:09	9:15	0:06	0	1	1	0	3	5
5	9:18	9:23	0:05	1	0	0	0	0	1
6	9:25	9:31	0:06	0	0	0	1	1	2
7	9:34	9:39	0:05	0	1	1	0	1	3
8	9:41	9:46	0:05	0	1	1	0	1	3
9	9:49	9:57	0:08	12	3	3	5	1	24
10	10:00	10:05	0:05	13	7	8	7	7	42
11	10:11	10:18	0:07	8	2	8	5	1	24
12	10:20	10:28	0:08	6	1	6	6	1	20
13	10:30	10:39	0:09	5	6	5	2	0	18
14	10:42	10:48	0:06	2	2	2	1	0	7
15	10:51	10:57	0:06	3	1	0	2	0	6
16	11:00	11:07	0:07	3	0	2	0	1	6
TOTAL	8:45	11:07	1:42	57	25	38	33	23	176

Efficiency (Artifacts/Minute) = 1.73

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 21SE   Surveyed: FEBRUARY 16, 1985

Sweep Positions:

A: Dave Kayser
B: Eileen Camilli
C: Igor Steel
D: John Roney
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:27	9:35	0:08	1	3	10	0	8	22
2	9:36	9:43	0:07	7	0	3	11	3	24
3	9:45	9:52	0:07	4	6	4	3	10	27
4	9:54	10:02	0:08	6	5	8	13	9	41
5	10:04	10:13	0:09	5	9	18	19	13	64
6	10:17	10:23	0:06	5	14	0	13	8	40
7	10:34	10:44	0:10	19	17	11	23	22	92
8	10:46	10:59	0:13	19	34	35	37	47	172
9	11:04	11:17	0:13	30	14	10	14	5	73
10	11:20	11:30	0:10	6	11	8	23	16	64
11	11:34	11:46	0:12	19	31	11	22	10	93
12	11:47	11:55	0:08	12	21	17	12	8	70
13	12:40	12:49	0:09	7	8	11	10	10	46
14	12:50	12:56	0:06	4	4	3	3	0	14
15	12:58	13:06	0:08	3	5	3	7	2	20
16	13:08	13:14	0:06	1	3	2	0	0	6
TOTAL	9:27	13:14	2:20	148	185	154	210	171	868

Efficiency (Artifacts/Minute) = 6.20

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 21NW Surveyed: FEBRUARY 8, 1985

Sweep Positions:

A: Dave Simons
B: Eileen Camilli
C: Igor Steel
D: Jane Pike
E: Dave Kayser

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	13:45	13:52	0:07	0	0	0	0	0	0
2	13:26	13:33	0:07	0	0	0	0	0	0
3	13:17	13:25	0:08	0	0	0	0	0	0
4	13:09	13:16	0:07	0	0	0	0	1	1
5	12:59	13:07	0:08	0	0	1	0	3	4
6	12:50	12:57	0:07	0	2	0	0	1	3
7	12:40	12:49	0:09	0	0	1	0	7	8
8	12:29	12:38	0:09	1	6	4	0	10	21
9	12:17	12:27	0:10	3	3	2	2	2	12
10	12:05	12:14	0:09	4	4	16	3	18	45
11	11:14	11:26	0:12	8	4	11	7	12	42
12	10:58	11:10	0:12	6	3	11	8	14	42
13	10:38	10:56	0:18	11	22	26	24	20	103
14	10:17	10:36	0:19	17	20	33	24	21	115
15	9:39	10:00	0:21	14	40	31	9	21	115
16	9:07	9:35	0:28	33	44	24	12	27	140
TOTAL	13:45	9:35	3:11	97	148	160	89	157	651

Efficiency (Artifacts/Minute) = 3.41

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 21NE Surveyed: FEBRUARY 7, 1985

Sweep Positions:

A: Dave Kayser
B: John Roney
C: Igor Steel
D: Alfred Hobbs
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:24	10:01	0:37	20	24	34	40	22	140
2	10:08	10:26	0:18	34	38	36	33	26	167
3	10:27	10:42	0:15	38	35	27	25	20	145
4	10:47	10:58	0:11	9	1	0	22	11	43
5	11:02	11:10	0:08	10	3	2	6	0	21
6	11:11	11:18	0:07	6	1	4	5	0	16
7	11:19	11:28	0:09	7	1	1	3	3	15
8	11:29	11:36	0:07	4	0	0	3	1	8
9	11:46	11:57	0:11	2	2	2	0	1	7
10	12:29	12:35	0:06	2	0	2	2	1	7
11	12:38	12:46	0:08	6	10	2	6	5	29
12	12:50	12:57	0:07	6	2	4	0	0	12
13	12:59	13:14	0:15	11	5	12	36	12	76
14	13:17	13:28	0:11	11	8	16	10	2	47
15	13:31	13:41	0:10	2	8	12	5	1	28
16	13:44	13:55	0:11	12	11	25	5	2	55
TOTAL	9:24	13:55	3:11	180	149	179	201	107	816

Efficiency (Artifacts/Minute) = 4.27

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 45NE · Surveyed: MARCH 13, 1985

Sweep Positions:

A: Dave Kayser
B: Cheryl Wase
C: Igor Steel
D: John Roney
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	A	B	C	D	E	Total
				Artifact Tallies					
1	9:06	9:14	0:08	5	1	3	1	0	10
2	9:15	9:25	0:10	2	3	4	12	11	32
3	9:26	9:35	0:09	2	6	5	20	17	50
4	9:38	9:48	0:10	2	18	9	6	3	38
5	9:51	10:04	0:13	7	14	9	11	10	51
6	10:05	10:14	0:09	6	4	1	2	5	18
7	10:16	10:24	0:08	7	15	3	4	4	33
8	10:25	10:35	0:10	9	8	7	13	14	51
9	10:36	10:49	0:13	16	11	11	25	16	79
10	10:52	11:06	0:14	36	41	10	10	20	117
11	11:08	11:23	0:15	16	24	8	21	10	79
12	11:24	11:38	0:14	8	18	20	34	15	95
13	12:40	12:49	0:09	3	1	4	14	16	38
14	12:50	13:08	0:18	14	31	25	51	41	162
15	13:11	13:25	0:14	13	29	5	24	21	92
16	13:27	13:39	0:12	10	16	5	14	3	48
TOTAL	9:06	13:39	3:06	156	240	129	262	206	993

Efficiency (Artifacts/Minute) = 5.34

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 45NW Surveyed: MARCH 5, 1985

Sweep Positions:

A: Eileen Camilli
B: Igor Steel
C: Kathy Niles
D: John Roney
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:27	9:35	0:08	0	2	6	1	8	17
2	9:37	9:43	0:06	1	2	0	1	0	4
3	9:50	9:56	0:06	2	3	2	0	1	8
4	9:58	10:04	0:06	1	5	4	1	0	11
5	10:07	10:15	0:08	3	23	3	15	4	48
6	10:16	10:24	0:08	8	3	12	9	8	40
7	10:26	10:35	0:09	29	10	12	11	4	66
8	10:37	10:47	0:10	17	6	13	9	21	66
9	10:49	11:19	0:30	39	48	93	73	60	313
10	11:21	11:35	0:14	40	42	39	31	19	171
11	12:18	12:32	0:14	32	20	27	16	22	117
12	12:34	12:49	0:15	35	47	42	38	19	181
13	12:56	13:07	0:11	17	23	27	21	26	114
14	13:09	13:17	0:08	10	6	8	3	2	29
15	13:19	13:27	0:08	1	2	2	2	4	11
16	13:29	13:36	0:07	4	2	3	2	4	15
TOTAL	9:27	13:36	2:48	239	244	293	233	202	1211

Efficiency (Artifacts/Minute) = 7.21

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 45SE Surveyed: FEBRUARY 27, 1985

Sweep Positions:

A: Dave Kayser
B: Cheryl Wase
C: Igor Steel
D: Alfred Hobbs
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:36	9:41	0:05	32	18	19	14	16	99
2	9:45	9:59	0:14	19	22	16	31	23	111
3	10:04	10:30	0:26	41	57	42	75	76	291
4	10:33	11:04	0:31	106	97	106	93	86	488
5	11:15	11:42	0:27	62	114	36	61	60	333
6	11:45	12:02	0:17	51	85	24	23	14	197
7	12:43	13:03	0:20	5	35	26	54	48	168
8	13:05	13:21	0:16	31	27	19	19	39	135
9	13:27	13:47	0:20	48	47	34	42	14	185
10	13:50	14:07	0:17	26	40	17	38	10	131
11	14:12	14:27	0:15	7	21	12	25	21	86
12	14:30	14:43	0:13	6	18	13	26	12	75
13	8:56	9:06	0:10	8	16	4	3	4	35
14	9:08	9:16	0:08	8	19	4	3	8	42
15	9:21	9:32	0:11	12	20	12	20	7	71
16	9:33	9:44	0:11	5	10	7	11	10	43
TOTAL	9:36	9:44	4:21	467	646	391	538	448	2490

Efficiency (Artifacts/Minute) = 9.54

431

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 45SW Surveyed: FEBRUARY 21, 1985

Sweep Positions:

A: Dave Kayser
B: Alfred Hobbs
C: Igor Steel
D: John Roney
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	9:44	10:20	0:36	0	0	0	0	0	0
2	9:52	9:57	0:05	0	0	0	1	0	1
3	10:00	10:05	0:05	0	0	1	0	0	1
4	10:07	10:13	0:06	0	0	0	0	1	1
5	10:15	10:22	0:07	12	1	0	0	0	13
6	10:27	10:33	0:06	0	1	3	1	0	5
7	10:35	10:41	0:06	3	1	1	2	0	7
8	10:43	10:51	0:08	3	4	0	1	0	8
9	10:54	11:00	0:06	1	0	1	3	2	7
10	11:02	11:11	0:09	2	2	0	4	0	8
11	11:13	11:19	0:06	2	1	5	1	3	12
12	11:22	11:32	0:10	2	8	12	14	12	48
13	11:35	11:45	0:10	12	53	13	20	29	127
14	11:48	12:01	0:13	33	12	3	2	0	50
15	12:04	12:16	0:12	3	26	10	17	11	67
16	12:18	12:33	0:15	4	12	18	14	8	56
TOTAL	9:44	12:33	2:40	77	121	67	80	66	411

Efficiency (Artifacts/Minute) = 2.57

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 48NE Surveyed: MARCH 15, 1985

Sweep Positions:

A: Dave Kayser
B: Kathy Niles
C: Igor Steel
D: John Roney
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	12:53	13:00	0:07	5	1	1	4	3	14
2	13:02	13:08	0:06	5	0	1	1	0	7
3	13:09	13:18	0:09	6	6	11	12	17	52
4	13:20	13:31	0:11	28	20	1	6	3	58
5	13:40	13:46	0:06	2	0	2	12	0	16
6	13:48	13:55	0:07	2	3	3	0	0	8
7	14:01	14:06	0:05	1	0	0	0	0	1
8	14:07	14:13	0:06	0	1	0	1	0	2
9	14:18	14:26	0:08	0	1	4	2	2	9
10	14:27	14:35	0:08	1	7	1	2	3	14
11	14:37	14:45	0:08	5	0	0	2	3	10
12	14:47	14:58	0:11	0	1	0	0	0	1
13	8:48	8:53	0:05	1	1	0	0	0	2
14	8:55	9:00	0:05	0	1	1	0	1	3
15	9:02	9:07	0:05	0	0	2	1	2	5
16	9:09	9:13	0:04	0	1	1	0	1	3
TOTAL	12:53	9:13	1:51	56	43	28	43	35	205

Efficiency (Artifacts/Minute) = 1.85

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 48NW Surveyed: MARCH 16, 1985

Sweep Positions:

A: Dave Kayser
B: Kathy Niles
C: Igor Steel
D: John Roney
E: Eileen Camilli

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	8:54	9:01	0:07	0	0	1	1	4	6
2	9:04	9:13	0:09	8	4	1	14	4	31
3	9:14	9:20	0:06	0	5	10	1	0	16
4	9:24	9:29	0:05	0	0	2	3	0	5
5	9:36	9:41	0:05	0	0	1	0	0	1
6	9:44	9:52	0:08	4	4	1	2	4	15
7	9:56	10:03	0:07	1	8	3	2	1	15
8	10:05	10:21	0:16	2	10	27	56	47	142
9	10:23	10:45	0:22	117	79	25	21	20	262
10	10:47	10:59	0:12	10	21	17	43	17	108
11	11:04	11:13	0:09	1	1	7	20	12	41
12	11:14	11:31	0:17	16	4	20	28	93	161
13	12:14	12:22	0:08	10	7	2	6	4	29
14	12:24	12:31	0:07	4	4	5	7	0	20
15	12:33	12:41	0:08	4	8	4	6	2	24
16	12:42	12:48	0:06	1	1	1	4	0	7
TOTAL	8:54	12:48	2:32	178	156	127	214	208	883

Efficiency (Artifacts/Minute) = 5.81

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 48SE Surveyed: MARCH 17, 1985

Sweep Positions:

A: Dave Simons
B: John Roney
C: Igor Steel
D: Kathy Niles
E: Dave Kayser

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	11:43	11:57	0:14	0	1	0	2	0	3
2	11:36	11:41	0:05	0	0	0	0	0	0
3	11:27	11:34	0:07	0	0	0	0	0	0
4	11:20	11:25	0:05	0	0	0	0	0	0
5	11:12	11:17	0:05	0	0	0	0	0	0
6	11:04	11:10	0:06	0	0	0	0	0	0
7	10:57	11:02	0:05	0	0	1	0	0	1
8	10:50	10:55	0:05	0	0	0	1	0	1
9	10:22	10:27	0:05	0	0	0	0	0	0
10	10:15	10:20	0:05	0	0	0	0	0	0
11	10:08	10:13	0:05	0	0	0	0	0	0
12	10:01	10:06	0:05	0	0	0	0	0	0
13	9:55	9:59	0:04	0	0	0	0	0	0
14	9:48	9:53	0:05	0	0	0	1	0	1
15	9:42	9:47	0:05	0	0	1	1	1	3
16	9:35	9:40	0:05	0	0	1	0	0	1
TOTAL	11:43	9:40	1:31	0	1	3	5	1	10

Efficiency (Artifacts/Minute) = 0.11

Bureau of Land Management
Navajo-Hopi Land Exchange Archaeological Project
Phase II

DISCOVERED ARTIFACT TALLY

Unit 48SW Surveyed: MARCH 14, 1985

Sweep Positions:

A: Dave Kayser
B: Eileen Camilli
C: John Roney
D: Igor Steel
E: Dave Simons

Sweep	Begin Time	End Time	Elapsed Time (Hrs:Mins)	Artifact Tallies A	B	C	D	E	Total
1	12:11	12:19	0:08	0	2	0	1	1	4
2	12:22	12:29	0:07	9	10	0	0	0	19
3	12:32	12:41	0:09	1	0	3	32	4	40
4	12:33	12:49	0:16	0	1	2	2	1	6
5	12:50	13:02	0:12	22	7	32	23	35	119
6	13:04	13:15	0:11	30	29	14	8	0	81
7	13:20	13:27	0:07	12	2	8	6	4	32
8	13:30	13:37	0:07	2	1	1	5	0	9
9	13:39	13:45	0:06	6	1	5	0	1	13
10	13:47	13:54	0:07	1	0	0	0	15	16
11	13:56	14:03	0:07	12	1	9	0	0	22
12	14:05	14:10	0:05	1	0	0	1	2	4
13	14:14	14:20	0:06	2	0	2	3	7	14
14	14:23	14:29	0:06	2	5	2	3	1	13
15	14:31	14:36	0:05	0	0	0	1	0	1
16	14:37	14:43	0:06	0	0	0	0	0	0
TOTAL	12:11	14:43	2:05	100	59	78	85	71	393

Efficiency (Artifacts/Minute) = 3.14

APPENDIX F
ASSEMBLAGE SUMMARIES FOR SURVEY UNITS

```
UNIT ASSEMBLAGE SUMMARY                                                                      100--------------------
                                                                                  N     %     P
AREA 1                        AREA (SQ. M.)   161043.70    CHIPPED STONE         191    11    E  80--------------------
                                                              FLKS/DEBRIS        174    10    R
UNIT    1                     DENSITY          0.010624       CORES               12     1    C  60--------------------
                                                              TOOLS                5     0    E
ASSEMBLAGE SIZE               BPUA (X 1000)    0.000066                                       N  40--------------------
    TOTAL              1711                                                                   T  ---------==---------
    FLAKE:TOOL RATIO  24.60                                GROUNDSTONE            37     2       20--==----====--------
    FLAKE:CORE RATIO  10.25                                FCR                  1459    85       --==============-----
                                                           CERAMICS               24     1       1 2 3 4 5 6 7 8 9 1
                                                                                                     S T A G E     0
                                                           FEATURES               15               ( 76 FLAKES)

                              MATERIAL TYPE %          FLAKE TOOLS %        COMPLETENESS %         STAGE        LENGTH       THINNESS
FLAKES          COUNT   %   GVOL CVOL  CCS  QTZ   SS   UTIL  RET  ACC   <1/2 >1/2  WHL  IND    MEAN  STD    MEAN  STD    MEAN  STD   WRATIO
 TOTAL            114  100     9   22   52    8    0      8    8    0      0   12   84    2     4.1 1.26    20.3 10.1     4.5 2.39    0.19

 UNDIFFERN        111   97     7   25   52    8    0      8    7    0      0   13   86    2     4.0 1.81    20.6 10.1     4.4 2.26    0.18
 BIF THINNING       0    0     0    0    0    0    0      0    0    0      0    0    0    0     0.0 0.00     0.0 0.00     0.0 0.00    0.00
 PRESSURE           1    1     0    0  100    0    0      0    0    0      0    0  100    0     7.9         12.0         12.0         0.00
 BIPOLAR            2    2   100    0    0    0    0      0   50    0      0    0  100    0                 24.0 9.90                  1.00

 DIST FRAGS         9          0    0   89    0    0     11   11    0

                              MATERIAL TYPE %          UTIL EDGES %                                  SIZE %                 CORTEX %
CORES           COUNT   %   GVOL CVOL  CCS  QTZ   SS   UTIL  RET  ACC                       0-3  3-6  6-10  10+       0  <1/2  >1/2
 TOTAL             12  100     8   17   67    0    0      0    0    0                        17   58   25     0       8   42    50

 UNDIFFERN          0    0     0    0    0    0    0      0    0    0                         0    0    0     0       0    0     0
 SINGLE PLATF       1    8     0  100    0    0    0      0    0    0                         0  100    0     0       0    0   100
 MULT PLATFRM      11   92     9    9   73    0    0      0    0    0                        18   55   27     0       9   45    45
 BIPOLAR            0    0     0    0    0    0    0      0    0    0                         0    0    0     0       0    0     0

 TST COBBLE         7         14   43   43    0    0      0   14    0                         0   57   29     0       0    0    86
 ANG DEBRIS        44          5   36   45    5    0      0    9    0                        23   55   18     2      25   30    32

                              MATERIAL TYPE %                              COMPLETENESS %         PORTION %             LENGTH
FORMAL TOOLS    COUNT   %   GVOL CVOL  CCS  QZT   SS                    <1/2 >1/2  WHL  IND   T/M BASE  WHL  IND      MEAN  STD
 TOTAl              5  100    20   20   60    0    0                       0   60   40    0    20   40   20    0      35.8 7.98

 UNIFACE 1          0    0     0    0    0    0    0                       0    0    0    0     0    0    0    0       0.0 0.00
 UNIFACE 2          0    0     0    0    0    0    0                       0    0    0    0     0    0    0    0       0.0 0.00
 UNIFACE 3          0    0     0    0    0    0    0                       0    0    0    0     0    0    0    0       0.0 0.00
 BIFACE 1           1   20   100    0    0    0    0                       0    0  100    0     0    0    0    0      27.0
 BIFACE 2           0    0     0    0    0    0    0                       0    0    0    0     0    0    0    0       0.0 0.00
 BIFACE 3           0    0     0    0    0    0    0                       0    0    0    0     0    0    0    0       0.0 0.00
 PROJ PNT           4   80     0   25   75    0    0                       0   75   25    0    25   50   25    0      38.0 7.26

                              MATERIAL TYPE %          UTIL EDGES %                                  SIZE               CORES   FCR
GROUNDSTONE     COUNT   %  CL-LM CVOL  CCS  QZT   SS   UTIL  RET  ACC                       0-3  3-6  6-10  10+      %       %
 TOTAL             37  100     5   32    3   32   24      0    0    0                         5   41   35    11      5      19

 HAMMERSTONE       10   27    10   60   10   10    0      0    0    0                         0   40   50     0     20      20
 HAND               3    8     0   67    0   33    0      0    0    0                         0   33   33    33      0       0
 HAND-GRSLAB        0    0     0    0    0    0    0      0    0    0                         0    0    0     0      0       0
 METATE             5   14    20    0    0   40   40      0    0    0                         0   20   40    40      0       0
 UNID FRAG         19   51     0   21    0   42   37      0    0    0                        11   47   26     5      0      26

FCR              1459         98    0    0    0    0                                          0   71   25     4

                COUNT      DIVERSITY INDEX      BWL/JAR RATIO
 CERAMICS          24           0.13                 0.2
```

437

TABLE F.1.
ASSEMBLAGE SUMMARY FOR AREA 1, UNIT 1.

TABLE F.2.

ASSEMBLAGE SUMMARY FOR AREA 1, UNIT 16.

```
UNIT ASSEMBLAGE SUMMARY                                                                         100
                                                                          N      %         P
AREA 1                               AREA (SQ. M.)   159273.94   CHIPPED STONE    1     20         E   80
                                                                   FLKS/DEBRIS    0      0         R
UNIT   16                            DENSITY          0.000031     CORES          1     20         C   60
                                                                   TOOLS                           E
ASSEMBLAGE SIZE                      DPUA (X 1000)    0.000000                                     N   40
     TOTAL                  5                                                                      T
     FLAKE:TOOL RATIO                                            GROUNDSTONE                           20
     FLAKE:CORE RATIO                                            FCR
                                                                 CERAMICS         4     80            1 2 3 4 5 6 7 8 9 1
                                                                                                        S T A G E       0
                                                                 FEATURES                                (      FLAKES)

                         MATERIAL TYPE %          FLAKE TOOLS %      COMPLETENESS %        STAGE       LENGTH       THINNESS
FLAKES        COUNT  %  GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC   <1/2 >1/2 WHL  IND    MEAN  STD    MEAN  STD    MEAN  STD  URATIO
 TOTAL

 UNDIFFERN
 BIF THINNING
 PRESSURE
 BIPOLAR

 DIST FRAGS

                         MATERIAL TYPE %           UTIL EDGES %                                 SIZE %              CORTEX %
CORES         COUNT  %  GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC                          0-3  3-6  6-10 10+      0  <1/2 >1/2
 TOTAL           1  100    0    0    0  100    0     0   0   0                            0    0   100   0      0   100    0

 UNDIFFERN       0    0    0    0    0    0    0     0   0   0                            0    0     0   0      0     0    0
 SINGLE PLATF    0    0    0    0    0    0    0     0   0   0                            0    0     0   0      0     0    0
 MULT PLATFRM    1  100    0    0    0  100    0     0   0   0                            0    0   100   0      0   100    0
 BIPOLAR         0    0    0    0    0    0    0     0   0   0                            0    0     0   0      0     0    0

 TST COBBLE      0         0    0    0    0    0     0   0   0                            0    0     0   0      0     0    0
 ANG DEBRIS      0         0    0    0    0    0     0   0   0                            0    0     0   0      0     0    0

                         MATERIAL TYPE %                            COMPLETENESS %        PORTION %          LENGTH
FORMAL TOOLS  COUNT  %  GVOL CVOL  CCS  QZT  SS                  <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND    MEAN  STD
 TOTAL

 UNIFACE 1
 UNIFACE 2
 UNIFACE 3
 BIFACE 1
 BIFACE 2
 BIFACE 3
 PROJ PNT

                         MATERIAL TYPE %           UTIL EDGES %                                 SIZE              CORES    FCR
GROUNDSTONE   COUNT  %  CL-LM CVOL  CCS  QZT  SS  UTIL RET ACC                          0-3  3-6  6-10 10+      %        %
TOTAL

HAMMERSTONE
MANO
MANO-GRSLAB
METATE
UNID FRAG

FCR

              COUNT      DIVERSITY INDEX       BWL/JAR RATIO
 CERAMICS       4             0.08                  0.0
```

TABLE F.3.
ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 3.

```
    UNIT ASSEMBLAGE SUMMARY                                                              100--------------------
                                                                                  N     %      P    --------------------
    AREA 2                            AREA (SQ. M.)   159704.16    CHIPPED STONE   23    62      E  80--------------------
                                                                     FLKS/DEBRIS   21    57      R    --------------------
    UNIT    3                         DENSITY          0.000232      CORES          2     5      C  60--------------------
                                                                     TOOLS                       E    --------------------
    ASSEMBLAGE SIZE                   DPUA (X 1000)    0.000001                                  N  40------##------------
         TOTAL                37                                                                 T    ------##------------
         FLAKE:TOOL RATIO                                          GROUNDSTONE      1     3         20------######--------
         FLAKE:CORE RATIO   7.50                                   FCR              1     3           --##--######--------
                                                                   CERAMICS        12    32          1 2 3 4 5 6 7 8 9 1
                                                                                                          S T A G E     0
                                                                   FEATURES                                (   9 FLAKES)

                             MATERIAL TYPE %        FLAKE TOOLS %     COMPLETENESS %         STAGE      LENGTH      THINNESS
FLAKES          COUNT  %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC    <1/2 >1/2 WHL  IND    MEAN  STD   MEAN  STD   MEAN  STD  URATIO
 TOTAL             14 100     0   29   36   21   0     7  29   0       0   14   86    0     3.7 1.31   39.8 16.2    3.5 1.40   0.56

 UNDIFFERN         14 100     0   29   36   21   0     7  29   0       0   14   86    0     3.7 1.31   39.8 16.2    3.5 1.40   0.56
 BIF THINNING       0   0     0    0    0    0   0     0   0   0       0    0    0    0     0.0 0.00    0.0 0.00    0.0 0.00   0.00
 PRESSURE           0   0     0    0    0    0   0     0   0   0       0    0    0    0     0.0 0.00    0.0 0.00    0.0 0.00   0.00
 BIPOLAR            0   0     0    0    0    0   0     0   0   0       0    0    0    0     0.0 0.00    0.0 0.00    0.0 0.00   0.00

 DIST FRAGS         1         0    0    0    0   0     0   0   0

                             MATERIAL TYPE %        UTIL EDGES %                                     SIZE %            CORTEX %
CORES           COUNT  %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC                              0-3  3-6  6-10 10+     0  <1/2 >1/2
 TOTAL              2 100     0  100    0    0   0     0   0   0                                0    0   50   50     0    0  100

 UNDIFFERN          0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0    0    0
 SINGLE PLATF       0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0    0    0
 MULT PLATFRM       2 100     0  100    0    0   0     0   0   0                                0    0   50   50     0    0  100
 BIPOLAR            0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0    0    0

 TST COBBLE         3         0   67    0    0   0     0   0   0                                0   67   33    0     0    0  100
 ANG DEBRIS         3         0   67   33    0   0     0  33   0                                0   67   33    0     0  100    0

                             MATERIAL TYPE %                          COMPLETENESS %          PORTION %         LENGTH
FORMAL TOOLS    COUNT  %   GVOL CVOL  CCS  QZT  SS                  <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND    MEAN  STD
 TOTAL

 UNIFACE 1
 UNIFACE 2
 UNIFACE 3
 BIFACE 1
 BIFACE 2
 BIFACE 3
 PROJ PNT

                             MATERIAL TYPE %        UTIL EDGES %                                     SIZE            CORES   FCR
GROUNDSTONE     COUNT  %  CL-LM CVOL  CCS  QZT  SS  UTIL RET ACC                              0-3  3-6  6-10 10+     %      %
TOTAL               1 100     0    0    0    0 100     0   0   0                                0    0  100    0     0      0

HAMMERSTONE         0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0      0
MANO                0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0      0
MANO-GRSLAB         0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0      0
METATE              1 100     0    0    0    0 100     0   0   0                                0    0  100    0     0      0
UNID FRAG           0   0     0    0    0    0   0     0   0   0                                0    0    0    0     0      0

FCR                 1         0    0    0  100   2                                              0    0  100    0

                COUNT      DIVERSITY INDEX      BWL/JAR RATIO
 CERAMICS        12             0.08                 0.7
```

TABLE F.4.

ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 25.

```
    UNIT ASSEMBLAGE SUMMARY                                                                        100--------------------
                                                                               N     %           P    --------------------
    AREA 2                          AREA (SQ. M.)   160530.33    CHIPPED STONE   820    49           E  80--------------------
                                                                   FLKS/DEBRIS   778    46           R    --------------------
    UNIT   25                       DENSITY          0.010483      CORES          27     2           C  60--------------------
                                                                   TOOLS          15     1           E    --------------------
    ASSEMBLAGE SIZE                 DPUA (X 1000)    0.000065                                        N  40--------------------
         TOTAL              1683                                                                     T    ----------##--------
         FLAKE:TOOL RATIO  34.60                                 GROUNDSTONE     182    11              20--------######------
         FLAKE:CORE RATIO  19.22                                 FCR             271    16                ------#########-----
                                                                 CERAMICS        410    24                1 2 3 4 5 6 7 8 9 1
                                                                                                             S T A G E     0
                                                                 FEATURES          6                       ( 299 FLAKES)

                                 MATERIAL TYPE %       FLAKE TOOLS %     COMPLETENESS %         STAGE       LENGTH      THINNESS
FLAKES         COUNT   %    GVOL CVOL  CCS  QTZ   SS   UTIL RET ACC   <1/2 >1/2 MHL  IND     MEAN  STD   MEAN  STD    MEAN  STD   URATIO
 TOTAL           436  100      1   24   65    8    1      1   0   0      1   19   80    0      5.1 1.48   23.6 10.8    4.5 2.31   0.02

 UNDIFFERN       429   98      1   24   65    8    1      1   0   0      1   19   80    0      5.1 1.48   23.6 10.8    4.5 2.29   0.02
 BIF THINNING      4    1      0    0  100    0    0      0   0   0      0   25   75    0      6.9 0.91   26.0 11.3    7.4 1.24   0.00
 PRESSURE          2    0     50    0   50    0    0      0   0   0      0    0  100    0      5.5 1.37    8.0 1.41    8.0 1.41   0.00
 BIPOLAR           1    0      0    0    0  100    0      0   0   0      0    0    0    0                                           0.00

 DIST FRAGS       83           0   37   53    8    0      1   1   0

                                 MATERIAL TYPE %        UTIL EDGES %                                 SIZE %            CORTEX %
CORES          COUNT   %    GVOL CVOL  CCS  QTZ   SS   UTIL RET ACC                         0-3  3-6  6-10  10+     0  <1/2 >1/2
 TOTAL            27  100      7   11   81    0    0      4   0   0                          19   59    15    4    22    41   37

 UNDIFFERN         5   19      0   20   80    0    0     20   0   0                           0   80    20    0    20    40   40
 SINGLE PLATF      0    0      0    0    0    0    0      0   0   0                           0    0     0    0     0     0    0
 MULT PLATFRM     19   70      0   11   89    0    0      0   0   0                          16   58    16    5    26    47   26
 BIPOLAR           3   11     67    0   33    0    0      0   0   0                          67   33     0    0     0     0  100

 TST COBBLE       10           0   30   50    0    0      0   0   0                           0   50    40    0     0     0  100
 ANG DEBRIS      249           0   24   53    9   10      0   0   0                          48   41     8    2    43    35   11

                                 MATERIAL TYPE %                          COMPLETENESS %        PORTION %           LENGTH
FORMAL TOOLS   COUNT   %    GVOL CVOL  CCS  QZT   SS                  <1/2 >1/2 MHL  IND   T/M BASE  MHL  IND     MEAN  STD
 TOTAL            15  100     13   13   73    0    0                     0   13   80    7     0    0    7    0     50.4 19.8

 UNIFACE 1         7   47     14   14   71    0    0                     0    0  100    0     0    0    0    0     48.2 18.2
 UNIFACE 2         3   20      0   33   67    0    0                     0   67   33    0     0    0    0    0     55.0   24
 UNIFACE 3         0    0      0    0    0    0    0                     0    0    0    0     0    0    0    0      0.0 0.00
 BIFACE 1          4   27      0    0  100    0    0                     0    0   75   25     0    0    0    0     57.0 23.8
 BIFACE 2          0    0      0    0    0    0    0                     0    0    0    0     0    0    0    0      0.0 0.00
 BIFACE 3          0    0      0    0    0    0    0                     0    0    0    0     0    0    0    0      0.0 0.00
 PROJ PNT          1    7    100    0    0    0    0                     0    0  100    0              100    0     28.0

                                 MATERIAL TYPE %        UTIL EDGES %                                  SIZE               CORES  FCR
GROUNDSTONE    COUNT   %   CL-LM CVOL  CCS  QZT   SS   UTIL RET ACC                         0-3  3-6  6-10  10+       %     %
TOTAL            182  100      1   21    3   39   35      0   0   0                          18   45    23    6       1    50

HAMMERSTONE       17    9      0   53   24   24    0      0   0   0                           0   29    53   12      12    24
MANO              17    9      0    6    0   24   71      0   0   0                          12   47    29    6       0    41
MANO-GRSLAB        3    2      0    0    0    0  100      0   0   0                           0    0    67   33       0    33
METATE            55   30      0   15    2   58   25      0   0   0                          24   40    22   11       0    56
UNID FRAG         90   49      2   23    1   34   38      0   0   0                          19   51    16    1       0    53

FCR              271          42   16    1   11   28                                          1   66    24   10

               COUNT       DIVERSITY INDEX      BML/JAR RATIO
 CERAMICS        410            0.42                 0.3
```

TABLE F.5

ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 32.

```
     UNIT ASSEMBLAGE SUMMARY                                                                         100--------------------
                                                                                         N     %      P        --------------------
     AREA 2                                 AREA (SQ. M.)   165951.09    CHIPPED STONE  332    46      E     80--------------------
                                                                            FLKS/DEBRIS 317    44      R       --------------------
     UNIT   32                              DENSITY          0.004345      CORES          8     1      C     60--------------------
                                                                            TOOLS          7     1      E       --------------------
     ASSEMBLAGE SIZE                        DPUA (X 1000)    0.000026                                  N     40--------------------
          TOTAL                     721                                                                T       ---------**---------
          FLAKE:TOOL RATIO  26.00                                          GROUNDSTONE    87    12             20-------******-------
          FLAKE:CORE RATIO  22.75                                          FCR           250    35               -----********-------
                                                                           CERAMICS       52     7               1 2 3 4 5 6 7 8 9 1
                                                                                                                    S T A G E      0
                                                                           FEATURES        1                         ( 104 FLAKES)

                             MATERIAL TYPE %          FLAKE TOOLS %     COMPLETENESS %         STAGE      LENGTH       THINNESS
FLAKES         COUNT    %  GVOL CVOL   CCS  QTZ   SS  UTIL  RET  ACC   <1/2  >1/2  WHL   IND    MEAN  STD   MEAN  STD    MEAN  STD  URATIO
 TOTAL           159  100     2   29    40   22    1     4    2    0      1    21   79     0     5.1 1.52   23.4 11.7     4.4 2.37    0.06

 UNDIFFERN       158   99     2   29    40   22    1     4    2    0      1    21   78     0     5.1 1.52   23.3 11.8     4.4 2.37    0.06
 BIF THINNING      0    0     0    0     0    0    0     0    0    0      0     0    0     0     0.0 0.00    0.0 0.00     0.0 0.00    0.00
 PRESSURE          0    0     0    0     0    0    0     0    0    0      0     0    0     0     0.0 0.00    0.0 0.00     0.0 0.00    0.00
 BIPOLAR           1    1     0    0   100    0    0     0    0    0      0     0  100     0                27.0                      0.00

 DIST FRAGS       23          0    4    52   39    0     4    0    4

                             MATERIAL TYPE %           UTIL EDGES %                                SIZE %                  CORTEX %
CORES          COUNT    %  GVOL CVOL   CCS  QTZ   SS  UTIL  RET  ACC                          0-3   3-6  6-10  10+       0  <1/2  >1/2
 TOTAL             8  100     0   13    88    0    0    13   13    0                            0    38    63    0      38    38    25

 UNDIFFERN         2   25     0    0   100    0    0    50    0    0                            0    50    50    0     100     0     0
 SINGLE PLATF      0    0     0    0     0    0    0     0    0    0                            0     0     0    0       0     0     0
 MULT PLATFRM      6   75     0   17    83    0    0     0   17    0                            0    33    67    0      17    50    33
 BIPOLAR           0    0     0    0     0    0    0     0    0    0                            0     0     0    0       0     0     0

 TST COBBLE        4          0   50    25    0    0     0    0    0                           25    25    50    0       0    25    75
 ANG DEBRIS      131          0   14    51   39   13     2    1    0                           64    41    11    2      53    33     3

                             MATERIAL TYPE %                            COMPLETENESS %           PORTION %        LENGTH
FORMAL TOOLS   COUNT    %  GVOL CVOL   CCS  QZT   SS                   <1/2  >1/2  WHL   IND  T/M  BASE   WHL  IND    MEAN   STD
 TOTAL             7  100    57   14    29    0    0                     29     0   71     0    0     0    43    0    28.9  12.5

 UNIFACE 1         2   29   100    0     0    0    0                     50     0   50     0    0     0     0    0    15.0  1.41
 UNIFACE 2         0    0     0    0     0    0    0                      0     0    0     0    0     0     0    0     0.0  0.00
 UNIFACE 3         0    0     0    0     0    0    0                      0     0    0     0    0     0     0    0     0.0  0.00
 BIFACE 1          1   14     0  100     0    0    0                      0     0  100     0    0     0     0    0    46.0
 BIFACE 2          1   14     0    0   100    0    0                    100     0    0     0    0     0     0    0    26.0
 BIFACE 3          0    0     0    0     0    0    0                      0     0    0     0    0     0     0    0     0.0  0.00
 PROJ PNT          3   43    67    0    33    0    0                      0     0  100     0               100    0    33.3  9.61

                             MATERIAL TYPE %           UTIL EDGES %                                SIZE          CORES   FCR
GROUNDSTONE    COUNT    % CL-LM CVOL   CCS  QZT   SS  UTIL  RET  ACC                          0-3   3-6  6-10  10+       %     %
 TOTAL            87  100     1   31     5   47   16     1    0    0                           11    48    25    3       6    48

 HAMMERSTONE      10   11     0   90    10    0    0     0    0    0                            0    20    80    0      40    20
 MANO              7    8     0   71    14    0   14     0    0    0                            0    43    43   14       0    57
 MANO-GRSLAB       0    0     0    0     0    0    0     0    0    0                            0     0     0    0       0     0
 METATE            8    9     0   25    13   38   25     0    0    0                            0    25    63   13       0    50
 UNID FRAG        62   71     2   18     2   61   18     2    0    0                           16    56    10    2       2    52

 FCR             250         72    3     2    9   12                                              0    81    14    4

               COUNT    DIVERSITY INDEX     BWL/JAR RATIO
 CERAMICS       52          0.21                0.2
```

TABLE F.6.
ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 50.

```
    UNIT ASSEMBLAGE SUMMARY                                                                             100--------------------
                                                                              N      %           P       --------------------
    AREA 2                             AREA (SQ. M.)   162139.84     CHIPPED STONE   476     23           E   80--------------------
                                                                       FLKS/DEBRIS   445     21           R     --------------------
    UNIT   50                          DENSITY          0.013044       CORES          14      1           C   60--------------------
                                                                       TOOLS          17      1           E     --------------------
    ASSEMBLAGE SIZE                    DPUA (X 1000)    0.000080                                          N   40--------------------
         TOTAL                  2115                                                                      T     --------##----------
         FLAKE:TOOL RATIO  17.65                                     GROUNDSTONE     215     10               20--------####--------
         FLAKE:CORE RATIO  21.43                                     FCR             202     10                 --#############-----
                                                                     CERAMICS       1222     58                 1 2 3 4 5 6 7 8 9 1
                                                                                                                  S T A G E       0
                                                                     FEATURES          7                           ( 198 FLAKES)

                           MATERIAL TYPE %         FLAKE TOOLS %      COMPLETENESS %          STAGE       LENGTH       THINNESS
FLAKES        COUNT   %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC   <1/2 >1/2 WHL  IND      MEAN  STD   MEAN  STD    MEAN  STD  URATIO
 TOTAL          276 100      2   24   51    8  10     3   5   0      0    9   90    0       4.4 1.63   27.6 12.7    4.1 2.04   0.09

 UNDIFFERN      266  96      2   24   50    8  11     3   5   0      0    9   90    0       4.3 1.59   27.9 12.8    4.0 1.85   0.09
 BIF THINNING     5   2      0    0  100    0   0     0   0   0      0    0  100    0       7.3 0.83   22.0 7.55    9.6 3.48   0.00
 PRESSURE         3   1      0    0  100    0   0     0   0   0      0    0  100    0       5.9 0.65   13.7 1.53    6.5 0.71   0.00
 BIPOLAR          2   1    100    0    0    0   0     0   0   0      0    0  100    0                  19.5 2.12               0.00

 DIST FRAGS      24          0   17   71    8   0     0  13   0

                           MATERIAL TYPE %         UTIL EDGES %                                  SIZE %              CORTEX %
CORES         COUNT   %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC                           0-3  3-6  6-10 10+      0  <1/2 >1/2
 TOTAL           14 100      7   43   36    0   7     0   7   0                             0   36   57    7      21   57   14

 UNDIFFERN        1   7    100    0    0    0   0     0   0   0                             0  100    0    0       0    0  100
 SINGLE PLATF     2  14      0   50    0    0   0     0   0   0                             0   50   50    0      50   50    0
 MULT PLATFRM    11  79      0   45   45    0   9     0   9   0                             0   27   64    9      18   64    9
 BIPOLAR          0   0      0    0    0    0   0     0   0   0                             0    0    0    0       0    0    0

 TST COBBLE       3         67   33    0    0   0     0   0   0                            67    0   33    0       0    0  100
 ANG DEBRIS     142          0   31   42    5  11     1   6   1                            39   47   11    3      40   38   13

                           MATERIAL TYPE %                            COMPLETENESS %           PORTION %            LENGTH
FORMAL TOOLS  COUNT   %   GVOL CVOL  CCS  QZT  SS                 <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND     MEAN  STD
 TOTAL           17 100     24    6   71    0   0                   12   18   59   12      6    6   29    0     34.5 16.4

 UNIFACE 1        3  18      0    0  100    0   0                    0    0   33   67      0    0    0    0     53.6   29
 UNIFACE 2        1   6      0    0  100    0   0                    0    0  100    0      0    0    0    0     31.0
 UNIFACE 3        0   0      0    0    0    0   0                    0    0    0    0      0    0    0    0      0.0 0.00
 BIFACE 1         5  29      0   20   80    0   0                   40    0   60    0      0    0    0    0     41.6 11.4
 BIFACE 2         0   0      0    0    0    0   0                    0    0    0    0      0    0    0    0      0.0 0.00
 BIFACE 3         1   6      0    0  100    0   0                    0  100    0    0      0    0    0    0     25.0
 PROJ PNT         7  41     57    0   43    0   0                    0   29   71    0     14   14   71    0     25.9 13.5

                           MATERIAL TYPE %          UTIL EDGES %                                   SIZE             CORES   FCR
GROUNDSTONE   COUNT   %  CL-LM CVOL  CCS  QZT  SS  UTIL RET ACC                           0-3  3-6  6-10 10+       %      %
TOTAL           215 100      0   17    1   50  31     0   0   0                            20   51   20    1       2     65

HAMMERSTONE      18   8      6   89    0    6   0     0   0   0                             6   44   50    0      17     39
MANO             29  13      0   17    0    3  79     0   0   0                             3   41   45    0       3     48
MANO-GRSLAB       0   0      0    0    0    0   0     0   0   0                             0    0    0    0       0      0
METATE           16   7      0   19    6   38  38     0   0   0                             0   31   56    6       0     56
UNID FRAG       152  71      0    9    1   65  25     0   0   0                            26   55    9    1       0     72

FCR             202         50   19    2    7  19                                           0   72   23    5

               COUNT        DIVERSITY INDEX      BWL/JAR RATIO
 CERAMICS      1222              0.50                 0.2
```

TABLE F.7.

ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 75.

```
    UNIT ASSEMBLAGE SUMMARY                                                                       100---------------------
                                                                          N       %            P      --------------------
    AREA 2                             AREA (SQ. M.)   163020.91   CHIPPED STONE  1333   63    E   80---------------------
                                                                     FLKS/DEBRIS  1227   58    R      --------------------
    UNIT   75                          DENSITY    ,     0.012968     CORES          62    3    C   60---------------------
                                                                     TOOLS          44    2    E      --------------------
    ASSEMBLAGE SIZE                    DPUA (X 1000)    0.000000                               N   40---------------------
         TOTAL               2114                                                              T      ---------##---------
         FLAKE:TOOL RATIO   21.02                                  GROUNDSTONE     265   13        20--------####-------
         FLAKE:CORE RATIO   14.92                                  FCR             388   18           #################----
                                                                   CERAMICS        128    6           1 2 3 4 5 6 7 8 9 1
                                                                                                        S T A G E       0
                                                                   FEATURES          0                   ( 550 FLAKES)

                                 MATERIAL TYPE %      FLAKE TOOLS %    COMPLETENESS %         STAGE      LENGTH      THINNESS
FLAKES          COUNT   %    GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC   <1/2 >1/2 MNL  IND    MEAN  STD   MEAN  STD   MEAN  STD   URATIO
 TOTAL            806 100       3   24   61    8   1      3   2   0      1   11  87    1     4.5 1.83  24.8 11.4    4.7 2.57   0.06

 UNDIFFERN        771  96       2   25   61    7   1      3   2   0      1   11  87    1     4.4 1.76  25.0 11.5    4.6 2.37   0.06
 BIF THINNING      28   3       4    7   75   14   0      4   4   0      4   18  79    0     7.2 1.12  21.9 7.62    7.2 4.75   0.08
 PRESSURE           3   0      33    0   67    0   0      0   0   0      0    0  67   33     7.3 0.66  12.5 0.71    9.5 4.95   0.00
 BIPOLAR            4   0      75    0    0   25   0      0   0   0      0    0 100    0                22.8 5.06               0.00

 DIST FRAGS       119           3   21   70    4   0      3   2   0

                                 MATERIAL TYPE %      UTIL EDGES %                                 SIZE %            CORTEX %
CORES           COUNT   %    GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC                         0-3  3-6  6-10 10+     0  <1/2 >1/2
 TOTAL             62 100       5   23   68    0   0      3   3   0                          10   58   24    0     13   52   31

 UNDIFFERN          0   0       0    0    0    0   0      0   0   0                           0    0    0    0      0    0    0
 SINGLE PLATF      10  16       0   20   80    0   0      0   0   0                          10   70   10    0     10   40   50
 MULT PLATFRM      51  82       4   24   67    0   0      4   4   0                           8   57   27    0     14   55   25
 BIPOLAR            1   2     100    0    0    0   0      0   0   0                         100    0    0    0      0    0  100

 TST COBBLE         4          25    0   25   25   0      0   0   0                          25   25   50    0      0    0   50
 ANG DEBRIS       298           2   26   49    7   9      2   5   0                          41   44   10    2     29   41   17

                                 MATERIAL TYPE %                       COMPLETENESS %          PORTION %          LENGTH
FORMAL TOOLS    COUNT   %    GVOL CVOL  CCS  QZT  SS                  <1/2 >1/2 MNL  IND    T/M BASE  MNL  IND    MEAN  STD
 TOTAL             44 100       7    9   80    2   0                    20   11  61    5      2   14    5    0    36.7 16.8

 UNIFACE 1         16  36       6   13   81    0   0                     6    0  88    6      0    0    0    0    41.5 18.5
 UNIFACE 2          2   5       0    0  100    0   0                     0    0 100    0      0    0    0    0    53.0   24
 UNIFACE 3          0   0       0    0    0    0   0                     0    0   0    0      0    0    0    0     0.0 0.00
 BIFACE 1           9  20      11    0   67   11   0                    22    0  67   11      0    0    0    0    38.9 10.9
 BIFACE 2           3   7       0   33   67    0   0                    33    0  67    0      0    0    0    0    28.3 5.69
 BIFACE 3           6  14       0    0  100    0   0                    67   33   0    0     17    0    0    0    25.3 7.20
 PROJ PNT           8  18      13   13   75    0   0                    13   38  38    0          75   25    0    32.0   15

                                 MATERIAL TYPE %      UTIL EDGES %                                 SIZE               CORES   FCR
GROUNDSTONE     COUNT   %  CL-LM CVOL  CCS  QZT  SS   UTIL RET ACC                          0-3  3-6  6-10 10+      %      %
TOTAL             265 100       2   22    2   36  39      0   1   0                          21   38   23    7      2     58

HAMMERSTONE        33  12       0   79    6   15   0      3   3   0                           0   30   42    6     12     12
MANO               37  14       0   19    0    0  81      0   0   0                           0   38   38    8      0     54
MANO-GRSLAB         1   0       0    0    0    0 100      0   0   0                           0    0  100    0      0    100
METATE             39  15       5   13    0   33  49      0   0   0                           3   36   33   28      0     54
UNID FRAG         155  58       2   13    1   50  34      0   1   0                          35   41   12    2      0     70

FCR               388          58   13    2    5  20                                          2   69   24    5

                COUNT       DIVERSITY INDEX      BML/JAR RATIO
 CERAMICS         128            0.33                  0.2
```

443

TABLE F.8.

ASSEMBLAGE SUMMARY FOR AREA 2, UNIT 110.

```
    UNIT ASSEMBLAGE SUMMARY                                                                       100---------------------
                                                                                    N     %     P    ---------------------
    AREA 2                            AREA (SQ. M.)  155342.91    CHIPPED STONE    546    42    E  80---------------------
                                                                    FLKS/DEBRIS    518    40    R    ---------------------
    UNIT  110                         DENSITY         0.000588      CORES           16     1    C  60---------------------
                                                                    TOOLS           12     1    E    ---------------------
    ASSEMBLAGE SIZE                   DPUA (X 1000)   0.000054                                  N  40---------------------
         TOTAL              1303                                                                T    ----------##---------
         FLAKE:TOOL RATIO  26.58                                  GROUNDSTONE      146    11       20---------######------
         FLAKE:CORE RATIO  19.94                                  FCR              570    44         --##--##########-----
                                                                  CERAMICS          41     3         1 2 3 4 5 6 7 8 9 1
                                                                                                        S T A G E     0
                                                                  FEATURES           4                   ( 162 FLAKES)

                          MATERIAL TYPE %        FLAKE TOOLS %     COMPLETENESS %          STAGE      LENGTH      THINNESS
FLAKES        COUNT   %  GVOL CVOL  CCS  QTZ   SS  UTIL RET ACC   <1/2 >1/2 WHL  IND    MEAN  STD  MEAN  STD   MEAN  STD  URATIO
 TOTAL          261 100     4   32   52    9    1     5   5   1      1   17  80    2     4.7 1.73  25.0 11.1    4.5 2.25   0.13

 UNDIFFERN      252  97     4   33   51   10    1     6   5   1      1   16  82    1     4.7 1.73  25.1 11.2    4.5 2.24   0.15
 BIF THINNING     6   2     0    0  100    0    0     0   0   0      0   67  17   17     5.3       24.0         8.0        0.00
 PRESSURE         0   0     0    0    0    0    0     0   0   0      0    0   0    0     0.0 0.00   0.0 0.00    0.0 0.00   0.00
 BIPOLAR          3   1    67    0   33    0    0     0   0   0      0    0 100    0               18.0 8.54               0.00

 DIST FRAGS      58         5   29   57    5    2     5   2   0

                          MATERIAL TYPE %        UTIL EDGES %                                    SIZE %             CORTEX %
CORES         COUNT   %  GVOL CVOL  CCS  QTZ   SS  UTIL RET ACC                              0-3  3-6 6-10 10+     0  <1/2 >1/2
 TOTAL           16 100    25    6   56    0    6     0   0   0                               25   50   25   0     0   56   44

 UNDIFFERN        1   6     0    0  100    0    0     0   0   0                              100    0    0   0     0  100    0
 SINGLE PLATF     1   6     0    0  100    0    0     0   0   0                                0    0  100   0     0    0  100
 MULT PLATFRM    11  69    18    9   55    0    9     0   0   0                               18   55   27   0     0   55   36
 BIPOLAR          3  19    67    0   33    0    0     0   0   0                               33   67    0   0     0   33   67

 TST COBBLE       8         0   25   50   25    0     0  13   0                               13   25   50  13     0    0   88
 ANG DEBRIS     191         2   25   34   10   21     1   5   0                               33   55    8   3    55   33   11

                          MATERIAL TYPE %                         COMPLETENESS %          PORTION %              LENGTH
FORMAL TOOLS  COUNT   %  GVOL CVOL  CCS  QZT   SS                 <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND      MEAN  STD
 TOTAL           12 100    25   17   50    0    0                   17   17  50   17     17    0    8    0      30.4   12

 UNIFACE 1        1   8     0    0  100    0    0                  100    0   0    0      0    0    0    0      25.0
 UNIFACE 2        2  17    50    0   50    0    0                    0    0 100    0      0    0    0    0      35.5 17.7
 UNIFACE 3        0   0     0    0    0    0    0                    0    0   0    0      0    0    0    0       0.0 0.00
 BIFACE 1         0   0     0    0    0    0    0                    0    0   0    0      0    0    0    0       0.0 0.00
 BIFACE 2         2  17    50    0   50    0    0                    0    0 100    0      0    0    0    0      36.0 15.6
 BIFACE 3         3  25     0   33   67    0    0                   33   33   0   33      0    0    0    0      22.3 12.2
 PROJ PNT         4  33    25   25   25    0    0                    0   25  50   25     50   25   25    0      32.5 11.2

                          MATERIAL TYPE %        UTIL EDGES %                                     SIZE            CORES   FCR
GROUNDSTONE   COUNT   % CL-LN CVOL  CCS  QZT   SS  UTIL RET ACC                              0-3  3-6 6-10 10+       %     %
TOTAL           146 100     1   19    3   37   40     1   0   0                               25   34   29   3       0    32

HAMMERSTONE      16  11     0   63   19   19    0     0   0   0                                6   31   56   0       0    19
MANO             18  12     6   11    0    6   78     0   0   0                                0   33   50   6       0    39
MANO-GRSLAB       0   0     0    0    0    0    0     0   0   0                                0    0    0   0       0     0
METATE           30  21     0   17    3   43   37     3   0   0                               27   27   37   7       0    33
UNID FRAG        82  56     0   13    0   45   40     0   0   0                               33   38   16   2       0    32

FCR             570        82    6    0    4    8                                               0   79   19   2

              COUNT     DIVERSITY INDEX     BWL/JAR RATIO
 CERAMICS       41           0.13                0.1
```

TABLE F.9.

ASSEMBLAGE SUMMARY FOR AREA 3, UNIT 2.

```
UNIT ASSEMBLAGE SUMMARY

AREA 3                                   AREA (SQ. M.)   645841.22      CHIPPED STONE    173   6    P 100--------------------
                                                                          FLKS/DEBRIS    150   5    E    --------------------
UNIT 2                                   DENSITY          0.004743        CORES           10   0    R  80--------------------
                                                                          TOOLS           13   0    C    --------------------
ASSEMBLAGE SIZE                          DPUA (X 1000)    0.000007                                  E  60--------------------
      TOTAL                    3063                                                                 N    --------------------
      FLAKE:TOOL RATIO         6.77                                                                 T  40--------------------
      FLAKE:CORE RATIO         8.80                                     GROUNDSTONE       46   2         ---------####---------
                                                                        FCR             2671  87       20---------####---------
                                                                        CERAMICS         173   6         --############-------
                                                                                                          1 2 3 4 5 6 7 8 9 1
                                                                        FEATURES           0                S T A G E       0
                                                                                                            ( 52 FLAKES)

FLAKES                           MATERIAL TYPE %        FLAKE TOOLS %     COMPLETENESS %        STAGE       LENGTH      THINNESS
 TOTAL          COUNT  %    GVOL CVOL  CCS  QTZ  SS    UTIL RET ACC    <1/2 >1/2 MHL  IND    MEAN  STD   MEAN  STD   MEAN  STD   URATIO
                  79  100     4   34   47    9    0      8   8   3       0    9   84    8     4.6 1.58   29.5 11.4    4.9 3.13   0.22
 UNDIFFERN        70   89     1   37   47    9    0      7   7   3       0    9   84    7     4.5 1.47   30.1 11.9    4.7 2.66   0.21
 BIF THINNING      4    5    25    0   50   25    0     25   0   0       0   25   75    0     7.8 0.30   22.3 4.62   11.6 7.60   0.33
 PRESSURE          0    0     0    0    0    0    0      0   0   0       0    0    0    0     0.0 0.00    0.0 0.00    0.0 0.00   0.00
 BIPOLAR           5    6    20   20   40    0    0      0  20   0       0    0   80   20                26.8 6.55               0.25

 DIST FRAGS        9          0   33   67    0    0      0   0   0

CORES                            MATERIAL TYPE %         UTIL EDGES %                                SIZE %              CORTEX %
 TOTAL          COUNT  %    GVOL CVOL  CCS  QTZ  SS    UTIL RET ACC                          0-3  3-6  6-10  10+      0  <1/2 >1/2
                  10  100    10   60   30    0    0      0   0   0                            0   20   20    30      0   30   10
 UNDIFFERN         2   20     0   50   50    0    0      0   0   0                            0    0    0     0      0    0    0
 SINGLE PLATF      3   30     0  100    0    0    0      0   0   0                            0    0   33    67      0    0   33
 MULT PLATFRM      5   50    20   40   40    0    0      0   0   0                            0   40   20    20      0   60    0
 BIPOLAR           0    0     0    0    0    0    0      0   0   0                            0    0    0     0      0    0    0

 TST COBBLE        3          0   33    0   33   33      0   0   0                            0   33   67     0      0    0   33
 ANG DEBRIS       59          3   41   36    5    5      3   0   0                            5   51   10     0     17   14   12

FORMAL TOOLS                     MATERIAL TYPE %                   COMPLETENESS %          PORTION %           LENGTH
 TOTAL          COUNT  %    GVOL CVOL  CCS  QZT  SS             <1/2 >1/2 MHL  IND    T/M BASE  MHL  IND    MEAN  STD
                  13  100    15   23   62    0    0               23   31   38    8      8    0   15    0    42.6  25.7
 UNIFACE 1         5   38    20   40   40    0    0               20   20   40   20      0    0    0    0    55.4  37.9
 UNIFACE 2         2   15     0    0  100    0    0               50   50    0    0      0    0    0    0    33.5    12
 UNIFACE 3         0    0     0    0    0    0    0                0    0    0    0      0    0    0    0     0.0  0.00
 BIFACE 1          0    0     0    0    0    0    0                0    0    0    0      0    0    0    0     0.0  0.00
 BIFACE 2          3   23    33    0   67    0    0                0   67   33    0      0    0    0    0    39.7  15.9
 BIFACE 3          1    8     0    0  100    0    0              100    0    0    0    100    0    0    0    25.0
 PROJ PNT          2   15     0   50   50    0    0                0    0  100    0               100    0    33.0  5.66

GROUNDSTONE                      MATERIAL TYPE %         UTIL EDGES %                            SIZE                CORES   FCR
 TOTAL          COUNT  %   CL-LM CVOL  CCS  QZT  SS    UTIL RET ACC                      0-3  3-6  6-10  10+        %      %
                  46  100     7   41    4   11   35      0   0   0                        0   37   48     7         0     11
 HAMMERSTONE       5   11     0   80    0   20    0      0   0   0                        0   20   80     0         0      0
 MANO             10   22    30   10    0   20   40      0   0   0                        0   40   40    10         0     10
 MANO-GRSLAB       1    2     0  100    0    0    0      0   0   0                        0    0  100     0         0      0
 METATE           21   46     0   33    5    5   52      0   0   0                        0   38   38    10         0     14
 UNID FRAG         9   20     0   67   11   11   11      0   0   0                        0   44   56     0         0     11

 FCR            2671         99    1    0    0    0                                       0   91    9     0

 CERAMICS       COUNT       DIVERSITY INDEX      BHL/JAR RATIO
                 173             0.21                 0.2
```

TABLE F.10.

ASSEMBLAGE SUMMARY FOR AREA 3, UNIT 3.

```
 UNIT ASSEMBLAGE SUMMARY                                                                          100-------------------------
                                                                          N        %          P       ------------------------
 AREA 3                              AREA (SQ. M.)  642227.10   CHIPPED STONE  2405     23         E   80-------------------------
                                                                 FLKS/DEBRIS   2348     22         R       ------------------------
 UNIT 3                              DENSITY          0.016980   CORES           84      1         C   60-------------------------
                                                                 TOOLS           53      0         E       ------------------------
 ASSEMBLAGE SIZE                     DPUA (X 1000)    0.000026                                     N   40-------------------------
      TOTAL              10905                                                                     T       ---------####----------
      FLAKE:TOOL RATIO   29.49                                  GROUNDSTONE     626      6             20---------####----------
      FLAKE:CORE RATIO   18.61                                  FCR            6674     61               --##############-------
                                                                CERAMICS       1120     10                1 2 3 4 5 6 7 8 9 1
                                                                                                              S T A G E      0
                                                                FEATURES         36                          ( 911 FLAKES)

                               MATERIAL TYPE %         FLAKE TOOLS %     COMPLETENESS %          STAGE       LENGTH       THINNESS
FLAKES          COUNT   %   GVOL CVOL  CCS  QTZ  SS    UTIL RET ACC    <1/2 >1/2 WHL  IND     MEAN  STD   MEAN  STD    MEAN  STD   URATIO
 TOTAL          1339  100     4   35   51    6    2      5    3   0      2   10   86    2      4.6 1.70   24.9 11.2    4.8 4.09    0.09

 UNDIFFERN      1256   94     3   36   49    6    2      5    3   0      2   10   86    2      4.5 1.66   25.4 11.2    4.7 4.10    0.09
 BIF THINNING     48    4     2    8   88    2    0      8    0   0      0   17   83    0      6.7 1.31   18.5 7.59    6.9 3.32    0.09
 PRESSURE         18    1     6   28   61    6    0      0    0   0      0    0   83   17      6.3 1.84    8.6 1.64    5.8 2.82    0.00
 BIPOLAR          17    1    35   18   41    6    0      6    6   0      0    6   88    6                 25.2 9.35                0.13

 DIST FRAGS      224          3   36   49    4    3      4    3   0

                               MATERIAL TYPE %          UTIL EDGES %                                 SIZE %               CORTEX %
CORES           COUNT   %   GVOL CVOL  CCS  QTZ  SS    UTIL RET ACC                        0-3  3-6  6-10 10+        0  <1/2 >1/2
 TOTAL            84  100     8   20   69    0    1      1    6   0                          6   68   18    0        13   42   25

 UNDIFFERN         6    7     0   33   67    0    0      0    0   0                          0   67   33    0         0   17   33
 SINGLE PLATF      9   11    11   22   67    0    0      0   22   0                          0   89   11    0        11   33   33
 MULT PLATFRM     67   80     7   19   70    0    1      1    4   0                          6   66   18    0        15   46   24
 BIPOLAR           2    2    50    0   50    0    0      0    0   0                         50   50    0    0         0    0    0

 TST COBBLE       26          8   54   31    4    0      0    4   0                         12   58   23    8         0   27   50
 ANG DEBRIS      759          1   46   33    7    6      2    2   0                         35   54    6    1        36   31   16

                               MATERIAL TYPE %                           COMPLETENESS %          PORTION %             LENGTH
FORMAL TOOLS    COUNT   %   GVOL CVOL  CCS  QZT  SS                    <1/2 >1/2 WHL  IND     T/M BASE  WHL  IND     MEAN  STD
 TOTAL            53  100    13    6   74    6    0                     13   11   66    9       0    8    9    0     39.0 15.8

 UNIFACE 1        18   34    11   11   78    0    0                      0    0   89   11       0    0    0    0     45.3   16
 UNIFACE 2         5    9     0    0   80    0    0                      0   60   40    0       0    0    0    0     44.4 10.1
 UNIFACE 3         0    0     0    0    0    0    0                      0    0    0    0       0    0    0    0      0.0 0.00
 BIFACE 1         11   21     0    0   82   18    0                     18    9   64    9       0    0    0    0     33.5 5.93
 BIFACE 2          4    8    25    0   75    0    0                     25    0   50   25       0    0    0    0     39.8 6.95
 BIFACE 3          5    9     0   20   60   20    0                     60    0   20   20       0    0    0    0     43.6 33.9
 PROJ PNT         10   19    40    0   60    0    0                     10   20   70    0       0   40   50    0     28.6 8.33

                               MATERIAL TYPE %          UTIL EDGES %                                  SIZE             CORES    FCR
GROUNDSTONE     COUNT   % CL-LM CVOL  CCS  QZT  SS    UTIL RET ACC                        0-3  3-6  6-10 10+        %       %
TOTAL            626  100     4   27    4   27   38      0    1   0                         16   43   21    4         1      37

HAMMERSTONE       72   12     4   72   15    7    1      0    0   0                          0   42   33    6         6       7
MANO             101   16     5   12    2    8   72      0    0   0                          4   38   38    5         0      25
MANO-GRSLAB        5    1     0    0    0    0  100      0    0   0                          0   60    0   20         0      20
METATE           151   24     5   27    1   17   50      0    1   0                          7   44   32    7         1      38
UNID FRAG        297   47     2   21    3   44   28      0    2   0                         28   44    7    2         0      47

FCR             6674         94    2    0    1    2                                          1   89   10    1

                COUNT       DIVERSITY INDEX       BWL/JAR RATIO
 CERAMICS       1120             0.58                  0.2
```

TABLE F.11.

ASSEMBLAGE SUMMARY FOR AREA 3, UNIT 21.

```
UNIT ASSEMBLAGE SUMMARY                                                                      100--------------------
                                                                              N       %    P    --------------------
AREA 3                           AREA (SQ. M.)   639548.59   CHIPPED STONE  1931      30    E  80--------------------
                                                               FLKS/DEBRIS  1821      28    R    --------------------
UNIT 21                          DENSITY          0.010115     CORES          66       1    C  60--------------------
                                                               TOOLS          44       1    E    --------------------
ASSEMBLAGE SIZE                  DPUA (X 1000)    0.000016                                  N  40--------------------
    TOTAL              6469                                                                 T    --------##----------
    FLAKE:TOOL RATIO  27.02                                  GROUNDSTONE     377       6       20--------######------
    FLAKE:CORE RATIO  18.02                                  FCR            3240      50         ----##########------
                                                             CERAMICS        921      14         1 2 3 4 5 6 7 8 9 1
                                                                                                   S T A G E       0
                                                             FEATURES         30                   ( 681 FLAKES)

                            MATERIAL TYPE %         FLAKE TOOLS %     COMPLETENESS %          STAGE       LENGTH      THINNESS
FLAKES         COUNT   %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC    <1/2 >1/2 WHL  IND      MEAN  STD   MEAN  STD   MEAN  STD  URATIO
 TOTAL          1032 100     3   30   57    8    0     6   3   0       2   13   85    0       4.8 1.63  23.7 11.7    4.6 2.61   0.10

 UNDIFFERN       947  92     2   32   55    8    0     6   3   0       2   14   84    0       4.6 1.55  24.6 11.5    4.3 2.27   0.10
 BIF THINNING     46   4     9    9   80    2    0     2   0   0       0   11   89    0       6.6 1.67  14.8 6.06    8.8 4.33   0.02
 PRESSURE         25   2     8    4   88    0    0     0   0   0       0    8   92    0       6.7 1.20   8.6 1.95    6.7 2.71   0.00
 BIPOLAR          14   1    36   21   43    0    0     7   0   0       0    0   93    7                 25.2 17.2                0.08

 DIST FRAGS      157         1   27   66    5    1     1   2   1

                            MATERIAL TYPE %         UTIL EDGES %                                   SIZE %              CORTEX %
CORES          COUNT   %   GVOL CVOL  CCS  QTZ  SS  UTIL RET ACC                           0-3  3-6  6-10 10+      0  <1/2 >1/2
 TOTAL            66 100     5   27   55    8    2     6   6   0                            11   42   39    0      20   64   15

 UNDIFFERN        10  15    20   30   30    0   10    20   0   0                            30   30   40    0      10   60   20
 SINGLE PLATF     13  20     8   15   46   23    0     8  15   0                             8   23   54    0       0   69   31
 MULT PLATFRM     42  64     0   31   62    5    0     2   5   0                             5   52   36    0      29   62   10
 BIPOLAR           1   2     0    0  100    0    0     0   0   0                           100    0    0    0       0  100    0

 TST COBBLE       24        17   38   33    4    8     0   4   0                            17   50   25    8       4   21   71
 ANG DEBRIS      608         1   42   35    6   14     2   2   0                            39   47    9    2      41   33    9

                            MATERIAL TYPE %                           COMPLETENESS %          PORTION %            LENGTH
FORMAL TOOLS   COUNT   %   GVOL CVOL  CCS  QZT  SS                  <1/2 >1/2 WHL  IND    T/M BASE  WHL  IND    MEAN  STD
 TOTAL            44 100    11    9   80    0    0                    16    5   77    2      0    7    9    0    42.7  16.8

 UNIFACE 1        12  27    17   25   58    0    0                     0    0  100    0      0    0    0    0    45.0  14.9
 UNIFACE 2         5  11     0    0  100    0    0                     0    0   80   20      0    0    0    0    49.0  3.74
 UNIFACE 3         0   0     0    0    0    0    0                     0    0    0    0      0    0    0    0     0.0  0.00
 BIFACE 1         13  30     8    8   85    0    0                    15    0   85    0      0    0    0    0    48.8  22.6
 BIFACE 2          5  11    20    0   80    0    0                    40    0   60    0      0    0    0    0    32.0  8.92
 BIFACE 3          2   5     0    0  100    0    0                   100    0    0    0      0    0    0    0    23.0
 PROJ PNT          7  16    14    0   86    0    0                    14   29   57    0          43   57    0    33.7  10.3

                            MATERIAL TYPE %         UTIL EDGES %                                   SIZE              CORES   FCR
GROUNDSTONE    COUNT   %  CL-LM CVOL  CCS  QZT  SS  UTIL RET ACC                           0-3  3-6  6-10 10+       %      %
TOTAL            377 100     4   26    5   24   40     1   0   0                             9   42   31    8       1     18

HAMMERSTONE       50  13     6   66   16    8    2     2   2   0                             2   24   58    4       4     12
MANO              64  17     6   27    5   11   52     0   0   0                             8   41   33    6       0     17
MANO-GRSLAB       13   3     0    0    0    0  100     0   0   0                             0   69   31    0       0     31
METATE           125  33     2   16    3   34   45     0   0   0                             7   42   34   15       0     19
UNID FRAG        125  33     5   22    3   31   38     1   0   0                            15   49   16    4       2     19

FCR             3240        92    2    0    1    5                                           0   84   15    2

               COUNT     DIVERSITY INDEX     BML/JAR RATIO
 CERAMICS        921          0.50               0.4
```

TABLE F.12.
ASSEMBLAGE SUMMARY FOR AREA 3, UNIT 45.

```
UNIT ASSEMBLAGE SUMMARY                                                                                 100--------------------
                                                                             N      %          P           --------------------
AREA 3                         AREA (SQ. M.)  640245.19   CHIPPED STONE   4154     50          E        80--------------------
                                                             FLKS/DEBRIS  3905     47          R           --------------------
UNIT 45                        DENSITY         0.012992     CORES          154      2          C        60--------------------
                                                             TOOLS           95      1          E           --------------------
ASSEMBLAGE SIZE                DPUA (X 1000)   0.000020                                        N        40--------------------
      TOTAL               8318                                                                 T           ---------####-------
      FLAKE:TOOL RATIO   27.51                            GROUNDSTONE      909     11                   20---------######-----
      FLAKE:CORE RATIO   16.97                            FCR             3143     38                      ----###########-----
                                                          CERAMICS         112      1                      1 2 3 4 5 6 7 8 9 1
                                                                                                             S T A G E       0
                                                          FEATURES          38                                (1506 FLAKES)

                                     MATERIAL TYPE %          FLAKE TOOLS %      COMPLETENESS %            STAGE        LENGTH        THINNESS
FLAKES           COUNT    %   GVOL CVOL  CCS  QTZ   SS    UTIL RET ACC     <1/2 >1/2 WHL   IND    MEAN  STD    MEAN  STD    MEAN  STD  URATIO
 TOTAL            2276  100      4   27   57    6    2       5   3   0        2   15   82     1     4.8 1.56    23.4 11.1     4.6 2.56   0.09

 UNDIFFERN        2167   95      4   28   57    7    2       5   4   0        2   15   82     1     4.8 1.53    23.8   11     4.5 2.50   0.09
 DIF THINNING       66    3      5   11   83    0    0       2   5   0        3   20   76     2     6.7 1.14    14.9 5.75     6.8 2.90   0.06
 PRESSURE           25    1      8   24   68    0    0       0   0   0        0   12   88     0     7.0 1.15     8.5 2.79     7.5 2.96   0.00
 BIPOLAR            18    1     44   22   28    0    6       0   0   0        0   22   72     6                 28.6   16                0.00

 DIST FRAGS        337           3   25   65    5    1       2   5   1

                                     MATERIAL TYPE %          UTIL EDGES %                                       SIZE %               CORTEX %
CORES            COUNT    %   GVOL CVOL  CCS  QTZ   SS    UTIL RET ACC                                 0-3  3-6  6-10 10+       0  <1/2 >1/2
 TOTAL             154  100      9   23   61    4    1       7   6   1                                  14   64   19    1       15   62   18

 UNDIFFERN          33   21     15   21   58    3    0      12   6   0                                  15   73   12    0       12   61   24
 SINGLE PLATF       17   11      6   18   59   18    0      12  12   0                                  12   59   24    0       24   47   18
 MULT PLATFRM      101   66      5   25   64    2    2       4   6   1                                  12   64   21    1       15   65   16
 BIPOLAR             3    2    100    0    0    0    0      33   0   0                                 100    0    0    0        0   55   33

 TST COBBLE         30          20   27   43    7    3       0   5   0                                  37   43   13    0        0   13   87
 ANG DEBRIS       1262           3   35   39   11    9       2   5   0                                  53   38    6    1       41   37   13

                                     MATERIAL TYPE %                             COMPLETENESS %            PORTION %              LENGTH
FORMAL TOOLS     COUNT    %   GVOL CVOL  CCS  QZT   SS                     <1/2 >1/2 WHL   IND    T/M BASE  WHL  IND        MEAN  STD
 TOTAL              95  100     12   11   72    2    0                       18   17   55     9      0    8    4    0        35.4 13.9

 UNIFACE 1          23   24      4   17   70    0    0                        4   17   61    17      0    0    0    0        40.7 14.6
 UNIFACE 2          24   25      8   17   71    0    0                       17   13   58    13      0    0    0    0        36.6 15.1
 UNIFACE 3           4    4      0    0  100    0    0                       25    0   75     0      0    0    0    0        24.0 12.9
 BIFACE 1           19   20     11    0   79    5    0                       21    5   58    11      0    0    0    0        38.2 13.4
 BIFACE 2           10   11      0   10   80   10    0                       20   20   60     0      0    0    0    0        33.2 8.51
 BIFACE 3            3    3     33    0   67    0    0                       67   33    0     0      0    0    0    0        31.0 15.7
 PROJ PNT           12   13     42    8   50    0    0                       25   42   33     0          67   33    0        25.3 7.90

                                     MATERIAL TYPE %          UTIL EDGES %                                      SIZE               CORES   FCR
GROUNDSTONE      COUNT    %  CL-LH CVOL  CCS  QZT   SS    UTIL RET ACC                                 0-3  3-6  6-10 10+        %      %
TOTAL              909  100      3   30    4   26   36       0   1   0                                  13   50   25    3         1     26

HAMMERSTONE         65    7      3   66   15   14    0       0   0   0                                   2   45   43    0         5     12
MANO               130   14      2   16    5   14   63       0   1   0                                   3   41   38    1         2     24
MANO-GRSLAB          8    1      0   25    0   13   63       0   0   0                                   0   25   63    0        13      0
METATE             208   23      1   28    0   32   37       0   0   0                                   8   45   35   10         0     29
UNID FRAG          498   55      4   30    4   29   32       1   1   0                                  20   56   11    1         0     27

FCR               3143          79    7    1    2   11                                                   0   85   15    1

                 COUNT       DIVERSITY INDEX      BWL/JAR RATIO
 CERAMICS         112             0.17                 0.2
```

418

TABLE F.13.

ASSEMBLAGE SUMMARY FOR AREA 3, UNIT 48.

```
        UNIT ASSEMBLAGE SUMMARY                                                                     100-------------------
                                                                                    N     %       P   --------------------
        AREA 3                       AREA (SQ. M.)   640012.07    CHIPPED STONE   474    25       E  80-------------------
                                                                    FLKS/DEBRIS   439    23       R   --------------------
        UNIT 48                      DENSITY          0.002981      CORES          21     1       C  60-------------------
                                                                    TOOLS          14     1       E   --------------------
        ASSEMBLAGE SIZE              DPUA (X 1000)    0.000005                                    N  40-------------------
             TOTAL              1908                                                              T   ---------##---------
             FLAKE:TOOL RATIO  18.43                              GROUNDSTONE     201    11          20---------####------
             FLAKE:CORE RATIO  12.29                              FCR             236    12           ################----
                                                                  CER^MICS        997    52           1 2 3 4 5 6 7 8 9 1
                                                                                                        S T A G E       0
                                                                  FEATURES         12                   ( 145 FLAKES)

                                  MATERIAL TYPE %          FLAKE TOOLS %      COMPLETENESS %        STAGE       LENGTH      THINNESS
    FLAKES          COUNT   %   GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC     <1/2 >1/2 WHL  IND    MEAN  STD    MEAN  STD   MEAN  STD   URATIO
     TOTAL            229  100     2   39   47    5   5      7   4   0        1   14   84    0     4.2 1.81    26.4   11    3.9 1.75   0.13

     UNDIFFERN        226   99     2   39   47    5   5      8   4   0        1   14   84    0     4.2 1.81    26.5   11    3.9 1.75   0.13
     BIF THINNING       1    0     0    0  100    0   0      0   0   0        0  100    0    0                                         0.00
     PRESSURE           1    0     0  100    0    0   0      0   0   0        0    0  100    0     6.0         11.0         5.5         0.00
     BIPOLAR            1    0   100    0    0    0   0      0   0   0        0    0  100    0                 25.0                     0.00

     DIST FRAGS        29          0   31   62    0   3     14   3   0

                                  MATERIAL TYPE %          UTIL EDGES %                                SIZE %                 CORTEX %
    CORES           COUNT   %   GVOL CVOL  CCS  QTZ  SS   UTIL RET ACC                       0-3  3-6  6-10  10+        0  <1/2  >1/2
     TOTAL             21  100     0   33   57    0   0      0   5   0                         0   76    19    0       29    48    19

     UNDIFFERN          1    5     0    0    0    0   0      0   0   0                         0    0     0    0        0     0     0
     SINGLE PLATF       1    5     0  100    0    0   0      0   0   0                         0  100     0    0        0     0   100
     MULT PLATFRM      19   90     0   32   63    0   0      0   5   0                         0   79    21    0       32    53    16
     BIPOLAR            0    0     0    0    0    0   0      0   0   0                         0    0     0    0        0     0     0

     TST COBBLE         5         40   40   20    0   0      0  20   0                [illegible]   80     0    0        0    20    80
     ANG DEBRIS       176          2   26   42    9  20      1   4   0                [illegible]   66    12    2       36    35    11

                                  MATERIAL TYPE %                             COMPLETENESS %       PORTION %             LENGTH
    FORMAL TOOLS    COUNT   %   GVOL CVOL  CCS  QZT  SS                    <1/2 >1/2 WHL  IND   T/M BASE  MHL  IND     MEAN  STD
     TOTAL             14  100    21    0   79    0   0                       7    7   64   21     0    0    7    0     41.9  15.5

     UNIFACE 1          5   36    20    0   80    0   0                       0    0   60   40     0    0    0    0     44.2  7.69
     UNIFACE 2          4   29     0    0  100    0   0                      25    0   75    0     0    0    0    0     39.8  19.1
     UNIFACE 3          0    0     0    0    0    0   0                       0    0    0    0     0    0    0    0      0.0  0.00
     BIFACE 1           2   14     0    0  100    0   0                       0    0  100    0     0    0    0    0     63.5  2.12
     BIFACE 2           1    7   100    0    0    0   0                       0  100    0    0     0    0    0    0     25.0
     BIFACE 3           1    7   100    0    0    0   0                       0    0    0  100     0    0    0    0     21.0
     PROJ PNT           1    7     0    0  100    0   0                       0    0  100    0             100    0     33.0

                                  MATERIAL TYPE %          UTIL EDGES %                                SIZE                CORES    FCR
    GROUNDSTONE     COUNT   %  CL-LM CVOL  CCS  QZT  SS   UTIL RET ACC                       0-3  3-6  6-10  10+        %        %
    TOTAL             201  100     1   28    4   12  53      0   1   0                         4   48    30    8        2       30

    HAMMERSTONE        27   13     0   89    0    7   4      0   0   0                         4   56    41    0       15       11
    MANO               42   21     0   14    5   10  69      0   0   0                         0   45    36   12        0       31
    MANO-GRSLAB         7    3     0   14    0   14  71      0   0   0                         0    0    57   29        0       14
    METATE             39   19     0   10    5    8  74      0   5   0                         0   41    33   10        0       36
    UNID FRAG          86   43     3   26    6   16  49      0   1   0                         9   55    20    3        0       35

    FCR               236         57   14    0    1  27                                        0   73    25    3

                    COUNT      DIVERSITY INDEX      BWL/JAR RATIO
     CERAMICS         997           0.63                 0.4
```

TABLE G-1
PROVENIENCES OF FLOTATION SAMPLES

SAMPLE NUMBER	SAMPLE VOLUME (ML)	CHARCOAL VOLUME (ML)	PERCENT VIEWED	UNIT	FEATURE	CONTEXT
E659	750	2	100	21SW	4	PIT STRUCTURE - FILL
E660	745	46	50	21SW	4	PIT STRUCTURE - FILL
E661	625	2	100	21SW	4	PIT STRUCTURE - FILL
E662	980	33	50	21SW	4	PIT STRUCTURE - INTERNAL PIT
E663	900	3	100	21SW	4	PIT STRUCTURE - FILL
E664	680	10	100	21SW	4	PIT STRUCTURE - INTERNAL PIT
E665	700	15	100	21SW	4	PIT STRUCTURE - INTERNAL PIT
E70	1545	1	100	45SE	2A	PIT
E99	1970	27	50	45SE	2C	PIT
E240	110	1	100	45SE	3A	SHALLOW STAIN
E155	1400	1	100	45SE	4	HEARTH/PIT
E216	1370	1	100	45SE	5	HEARTH/ PIT
E230	1210	2	100	45SE	7B	PIT OR HEARTH
E259	1170	3	100	45SE	8A	POSSIBLE PIT STRUCTURE
E266	2600	4	100	45SE	8H	DARK STAIN IN FEA. 8A
E274	1560	3	100	45SE	8Q	DARK STAIN IN FEA. 8A
E160	1640	13	100	45SE	10A	PIT -UPPER FILL
E161	1310	8	100	45SE	10A	PIT -LOWER FILL
E200	1000	1	100	45SE	11A	SHALLOW STAIN
E190	1290	29	50	45SE	12	PIT - LOWER FILL
E191	990	81	50	45SE	12	PIT - LOWER FILL
E192	1930	99	35	45SE	12	PIT - LOWER FILL
E193	1590	63	50	45SE	12	PIT - LOWER FILL
E201	790	1	100	45SE	13A	PIT STRUCTURE
E163	1330	16	100	45SE	14A	SHALLOW STAIN
E208	1010	2	100	45SE	16	HEARTH/PIT
E325	2250	199	15	45SE	18	PIT - STRATUM 2
E326	2180	861	15	45SE	18	PIT - STRATUM 3
E329	270	21	100	45SE	18	PIT - UPPER FILL
E121	2045	11	100	45SW	3	PIT STRUCTURE
E122	1990	11	100	45SW	3	PIT STRUCTURE
E131	670	1	100	45SW	4	SHALLOW STAIN
E368	1500	1	100	48NW	3A	FEA. FILL
E388	2190	39	50	48NW	5A	PIT STRUCTURE
E392	1210	2	100	48NW	6	FEA. FILL
E572	2610	1	100	48SW	3A	FEA. FILL
E570	1650	17	100	48SW	4A	PIT STRUCTURE - FILL
E593	1280	26	50	48SW	4A	PIT STRUCTURE - FILL
E613	1380	16	100	48SW	4A	PIT STRUCTURE - HEARTH
E626	2220	4	100	48SW	4A	PIT STRUCTURE - HEARTH
E592	1750	2	100	48SW	4B	FEA. FILL
E633	2660	3	100	50	4	PIT STRUCTURE - FILL
E656	1510	6	100	75	5A	PIT STRUCTURE - FILL
E654	1230	3	100	75	5B	EXTERNAL HEARTH

BLANK

PAGE

BLANK

PAGE

Table G-2. Seeds from flotation samples.

SAMPLE NUMBER	AMARA	ASTRA	BAMU	CHAM	CHENO-PODIACEAE	CHENO	ASTER	DEPI	DIWI	ERIOG	EUSE5	EUSE6	GRAMI	HEPE	PORTU	SPHAE	SPORO	YUEL	UNKNOWN	UNIDENTI-FIABLE
E659	(27)	---	---	---	---	---	(1)	---	---	(5)	(62)	(1)	---	---	(50)	---	---	---	---	---
E660	(1)	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E661	(3)	---	---	---	---	---	---	---	(1)	---	(2)	---	---	---	(8)	---	---	---	---	---
E662	---	(1)	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E663	---	---	---	---	---	---	---	---	---	---	(2)	---	---	---	(4)	---	---	---	---	2
E664	---	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	1	---	---	---	---
E665	(3)	(1)	---	1	---	---	---	---	---	---	(13)	---	---	---	(10)	---	---	---	---	1
E70	(1)	---	---	---	---	---	---	---	---	---	(1)	(1)	---	(2)	(9)	---	---	---	---	---
E99	(1)	2	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E240	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
E155	(1)	---	---	---	---	---	---	---	---	---	(11)	---	---	(1)	(2)	---	---	---	---	---
E216	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	(1)	---	---	---	---	---
E230	---	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E259	(2)	---	---	---	---	(1)	---	---	---	---	---	---	---	(15)	---	---	---	---	---	---
E266	---	---	---	(1)	---	---	---	---	---	---	(1)	---	---	(279)	---	---	---	(1)	---	---
E274	(1)	---	---	---	---	---	---	---	---	---	(13)	---	---	(2)	---	---	---	---	---	---
E160	---	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E161	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
E200	(1)	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---	---	---	---	---
E190	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1+(1)	---	---	---	---	1
E191	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	---	---
E192	---	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E193	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	---	---	---	---	---
E201	---	---	---	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	---
E163	---	---	---	---	---	(1)	---	---	---	---	---	(6)	---	(5)	(1)	---	---	---	---	---
E208	---	---	---	---	---	---	---	(1)	(1)	---	---	---	---	---	---	---	---	---	---	---
E325	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
E326	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
E329	---	---	---	---	---	---	(1)	---	---	---	---	---	---	---	---	---	---	---	---	---
E121	---	---	---	---	---	---	---	---	---	---	(2)	(7)	---	(1)	(1)	---	---	(1)	---	---
E122	---	---	---	---	---	---	---	---	---	---	(4)	(7)	---	---	---	---	---	---	---	---
E131	---	---	---	---	---	---	---	---	---	---	---	(10)	---	---	---	---	---	---	---	---
E368	(1)	---	(1)	---	---	---	---	---	---	---	---	(1)	2	(4)	---	---	---	---	---	1
E388	---	---	---	---	---	---	---	---	---	---	---	(3)	---	(2)	---	---	19	---	---	---
E392	---	---	---	---	---	---	---	---	---	---	---	(3)	1	(1)	(1)	---	2	---	---	---
E572	(3)	---	---	---	---	---	---	---	---	---	---	(5)	---	(3)	---	---	---	---	(1)	---
E570	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	82	---	---	1
E593	---	---	---	---	1	---	---	---	---	---	---	(1)	---	---	---	---	2	---	---	---
E613	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	---	---	351	---	---	---
E626	---	---	---	---	---	---	---	---	---	---	---	(55)	---	1	---	---	71	---	(1)	2
E592	---	---	---	---	---	---	---	---	---	---	---	(30)	---	2	(3)	---	5+(1)	(1)	(3)	---
E633	---	---	---	---	---	---	---	---	---	---	---	(1)	---	---	(1)	---	---	---	---	---
E656	---	---	---	---	---	---	---	---	---	---	---	(3)	---	---	(2)	---	---	---	---	---
E654	---	---	---	---	---	---	(1)	---	---	---	---	---	---	---	---	---	---	---	---	---

KEY (PLANT SPECIES):

AMARA-*Amaranthus* sp.
ASTRA-Cf. *Astragalus* sp.
BAMU-Cf. *Baileya multiradiata*
CHAM-*Chenopodium ambrosiodes*
CHENO-*Chenopodium* sp.
ASTER-*Compositae*
DEPI-*Descurainia pinnata*
DIWI-*Dithyraea wislizeni*
ERIOG-Cf. *Eriogonum*
EUSE5-*Euphorbia* Cf. *serpyllifolia*
EUSE6-*Euphorbia* Cf. *serrula*
GRAMI-Gramineae
HEPE-*Helianthus petiolaris*
PORTU-*Portulaca* sp.
SPHAE-Cf. *Sphaeralcea* sp.
SPORO-*Sporobolus* sp.
YUEL-Cf. *Yucca elata*

NOTE: ()--Unburned seeds are indicated by parentheses.

TABLE G-3
CHARCOAL FROM FLOTATION SAMPLES

SAMPLE NUMBER	CF.*ATRIPLEX CANESCENS*	CF.*PROSOPIS GLANDULOSA*	*PROSOPIS GLANDULOSA*	GRAMINEAE (STEMS)	CF.*YUCCA ELATA* (FLOWER STALK)
E660	-	2	---	--	-
E662	-	-	3	--	-
E665	-	7	---	--	-
E99	1	-	---	--	-
E160	-	1	---	--	-
E190	-	-	10	--	-
E191	-	7	4	--	-
E192	-	-	20*	--	-
E193	-	-	4	--	-
E325	-	5	12	--	-
E326	-	-	20*	--	-
E329	-	-	8	--	-
E121	-	-	---	2	-
E388	-	-	---	3	-
E570	-	-	---	13	3
E593	-	-	---	7	8
E613	-	-	---	47	1
E626	1	-	---	9	-
E633	-	1	---	--	-
E656	-	-	1	--	-

NOTE: *Random sample of wood charcoal.

TABLE G-4
EXCAVATED MACROFLORAL SPECIMENS

SAMPLE NUMBER	UNIT	FEATURE	CONTEXT	IDENTIFICATION
E678	21SW	4	PIT STRUCTURE-FILL	UNBURNED SEED OF *PROSOPIS GLANDULOSA*
E93	45SE	2D	PIT STRUCTURE-FILL	BURNED FLOWER STALK OR POD-FLILIACEAE
E317	45SE	18	PIT-STRATUM 2	BURNED POD OF CF. *YUCCA ELATA*
E319	45SE	18	PIT-STRATUM 3	RANDOM SAMPLE OF WOOD CHARCOAL - 20 PIECES OF *PROSOPIS GLANDULOSA*
E448	48SW	4A	PIT STRUCTURE-FILL	UNBURNED SEED OF *PROSOPIS GLANDULOSA*
E576	48SW	4A	PIT STRUCTURE-FLOOR	UNBURNED SEED OF *EUPHORBIA* CF. *SERRULA* 4 BURNED SEEDS OF *SPOROBOLUS* sp. 19 BURNED STEMS OF GRAMINEAE 31 BURNED LEAVES OF *YUCCA ELATA*
E545	48SW	4A	PIT STRUCTURE-FILL	3 BURNED STEMS OF GRAMINEAE

APPENDIX H

POLLEN ANALYSIS By Linda J Scott

Twelve pollen samples were selected for pollen analysis in conjunction with the Navajo-Hopi Land Exchange Archaeological Project in the BLM designated Survey Area III. The study area is situated in a coppice dune topography above the floodplain of the Rio Grande west of El Paso. Mesquite is the dominant element in this sparsely vegetated area. All features sampled for pollen were contained within Area III. The features included small pits or hearths, pitstructures, and hearths and pit features within pit structures ranging in age from 1015 B.C. to A.D. 1045.

METHODS

A chemical extraction technique based on flotation is the standard preparation technique used in this laboratory for the removal of the pollen from the large volume of sand, silt, and clay with which they are mixed. This particular process was developed for extraction of pollen from soils where preservation has been less than ideal and pollen density is low.

Hydrochloric acid (10 percent) was used to remove calcium carbonates present in the soil, after which the samples were screened through 150 micron mesh. Zinc bromide (density 2.0) was used for the flotation process. All samples received a short (10 minute) treatment in hot hydrofluoric acid to remove any remaining inorganic particles. The samples were then acetolated for 3 minutes to remove any extraneous organic matter.

A light microscope was used to count the pollen to a total of 100 to 200 pollen grains at a magnification of 430x by Linda Scott and Kate Aasen. Pollen preservation in these samples varied from good to poor. Comparative reference material maintained at this laboratory was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen, and may be interpreted to represent pollen dispersal over short distances, or the actual introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagram (see Chapter 9, Figure 9.26).

The features sampled (Table H-1), in all probability, represent separate occupations. The pollen record is nearly complete for the samples submitted. Three samples did not yield sufficient pollen for analysis, and include the earliest features sampled, with radiocarbon dates ranging from 1920 ± 50 B.C. to 1065 ± 95 B.C. The pollen records from the features yielding counts are varied, suggesting the utilization of several vegetal resources.

The pollen record from the present ground surface (E176) reflects an environment of mesquite, Cheno-ams (probably the *Atriplex* reported), sagebrush, various composites, spurge (*Euphorbia*), mint (Labiatae), mustard (Cruciferae), and Mormon tea (*Ephedra*) (Table H-2). No grass was recorded in this area, but a single Gramineae pollen grain was recorded from the present ground surface. Other elements of the pollen record include longer distance transport of pine (*Pinus*), juniper (*Juniperus*), oak (*Quercus*), and rose family (*Rosaceae*).

SAMPLES

Unit 21SW

Feature 4. Sample E686 was taken from an internal pit within a pit structure, and exhibits a pollen record similar in distribution to that of the present ground surface with certain exceptions. The Gramineae pollen frequency in Sample E686 is somewhat larger than that of the present ground surface indicating that the pit may have been lined with grass, or may have been used to store or process grass seeds. Members of the grass family (Gramineae) are noted to have been exploited for their seeds, which were ground and used for a variety of mushes, bread, and

454

cakes (Colton 1974:338, 365; Cushing 1920:219, 253-254; Whiting 1939:65). Of the grasses growing in this area, *Sporobolus* is the most likely to have been exploited for its seeds (Kearney and Peebles 1960; O'Laughlin 1980). Bye (1972) reports that the Paiute used both *Muhlenbergia* and *Panicum* seeds as food items. In addition, grasses may be used to line caches (Smith 1974) or to line roasting pits.

Unit 48SW

Feature 4A. Two pollen samples were taken from this feature: Sample E580 from the floor of the pit structure, and E623/624 from the interior hearth fill. The pollen records from these two samples are remarkably similar to one another. Both exhibit extremely elevated Gramineae frequencies (49 percent and 54 percent). In addition, both samples also contained increased *Euphorbia* pollen frequencies. These two plants were evidently used or processed in the hearth and the pit structure in quantity. *Euphorbia* is noted to have been used primarily as a medicine to increase the flow of milk in lactating women, for boils and pimples, and as a linament (Elmore 1944:60; Stevenson 1915:51; Vestal 1952:35; Whiting 1939:83). The Apache used *Euphorbia* root as an additive to tulipai, a fermented corn beverage (Gallagher 1977:61,62,65).

Typha/Sparganium pollen was also observed in Sample E580 from the floor of the pit structure, suggesting the exploitation of this riparian plant. Steward (1938) and Chamberlin (1911) note the utilization of cattail as food; and Harrington (1967) describes the use of both pollen and the seed-like fruits of cattail as food resources. The young pollen-producing flowers may be stripped from the spikes, or the pollen may be removed by shaking the mature flowers. The resulting flowers or pollen may be mixed with flour. Flour made from cattail roots, which are best harvested in the fall, is similar with respect to quantities of fats, proteins, and carbohydrates to flour obtained from wheat, rice, and corn (Harrington 1967). The sample from the hearth in this pit structure (E623/624) contained a small quantity of Cruciferae pollen, which may be the result of processing a member of the mustard family. Several members of this family are noted to have been utilized by various Indian groups as food (both the greens and seeds) (Castetter and Bell 1960:62; Colton 1974:309-310,366; Stevenson 1915:60; Whiting 1939:77).

Unit 45SE

Feature 4. This sample (E157), taken from a small pit,exhibited an assemblage of pollen similar to that of the present ground surface, but did not contain similar frequencies of many of the pollen taxa. No *Prosopis* pollen was observed in this sample. Instead, the dominant element was *Euphorbia* pollen. Other members of the pollen record were similar to those of the present ground surface, with the exception that very little arboreal pollen was noted. The very large quantity of *Euphorbia* pollen observed in this hearth sample suggests that this plant may have been processed in the pit.

Feature 5. This feature, a shallow hearth/pit (Sample E217), exhibited a very large quantity of Cheno-am pollen in comparison with the present ground surface and the features occupied during the 700s, 800s, and 900s A.D. This large frequency of Cheno-am pollen may be associated with the exploitation of this resource. *Atriplex* seeds are noted to have been used both raw and ground into meal. Although not as plentiful in this environment, both *Chenopodium* and *Amaranthus* produce greens and seeds that have been widely exploited for food (Castetter and Bell 1942:61,62; Colton 1974:292; Kearney and Peebles 1960:251,255,265; Robbins et al. 1916:29,75,89; Stevenson 1915:44,66; Whiting 1939:73).

This feature also contained a large quantity of High-spine Compositae pollen, similar to that in Sample E686 (21SW-Feature 4). This frequency is higher than that observed in the sample from the present ground surface, but may still represent naturally occurring pollen rain. It should also be noted that members of the morphological pollen group of High-spine Compositae includes *Helianthus* (sunflower). Sunflower seeds are very rich in oil, and may be ground into paste for batter or roasted and eaten. Other members of the Compositae family are used in a variety of ways, including medicinally, as food, dye, and fuel (Kearney and Peebles 1960:709; Whiting 1939:94-99). A small quantity of *Prosopis* pollen was also recovered from this sample, suggesting processing and utilization of this resource. Kearney and Peebles (1960:402) and Castetter and Bell (1960:60) record the importance of *Prosopis* to Indians of the Southwest. The sweet pods may be ground to make pinole, which is a versatile meal used as a staple food of the Pima. Fermented pinole is noted to have been a favorite drink. In addition, mesquite gum may be used to make candy, mend pottery, and as a black dye.

Feature 18. Feature 18, a deep (40 centimeters) bowl-shaped pit, was sampled in its lower portion for pollen (E330). The pollen record from this sample includes a larger frequency of *Pinus* pollen (7 percent) than noted in other samples from this area, but does not appear to be large enough to substantiate exploitation of this resource. The contents of this sample are similar to those of the present ground surface, with the exception that more Compositae and no *Prosopis* pollen were observed in this hearth. A small quantity of *Shepherdia* pollen was recovered from this sample, suggesting that this resource was utilized. The berries may be eaten either raw or cooked, and may also be dried for winter use or used to flavor meat (Harrington 1967:282-284; Kearney and Peebles 1960:587; Smith 1974:269).

Feature 12. This pit was sampled in Stratum 3, a part of the lower fill, which was described as a blue-grey ash. The sample (E179) contains pollen typical of the local environment, although it exhibits a Cheno-am frequency almost as large as that in Sample 217, as well as the largest quantity of *Ephedra* pollen (4 percent), and a larger Gramineae frequency (5 percent) than the present ground surface. *Ephedra* is noted to have been used primarily as a medicinal tea, although the tea may also be drunk as a beverage (Colton 1974:312; Kearney and Peebles 1960:60; Robbins et al. 1916:46; Stevenson 1915:49,67; Whiting 1939:73-74). All three of these plants are noted to have been exploited as food items, and also for various utility purposes.

Feature 10A. The pollen sample (E158) was taken from the lower stratum of this pit. A radiocarbon age of 1015 ± 230 B.C. was returned for this feature. The pollen record from this pit is largely unremarkable. It exhibited a large quantity of High-spine Compositae pollen, which may reflect either natural pollen rain or processing of a member of the composite family--perhaps sunflower. No other components of the pollen record are suggestive of the exploitation of native vegetal resources.

SUMMARY AND CONCLUSIONS

The pollen record from features sampled in Area III in the West Mesa environmental zone is highly variable. The limited quantity of features represented makes recognition of a pattern, either temporal or related to feature type, very difficult. Three larger pits in Unit 45SE yielded sufficient pollen for analysis (Sample E158, E179, and E330). The pit features in Unit 45SE contain little pollen evidence of the exploitation of native resources; potential economic pollen does include, however, Cheno-ams (possibly *Atriplex*), *Ephedra*, High-spine Compositae, and *Shepherdia*. Pollen was also analyzed from two pit structures (E636 and E580) in Units 21SW and 48NW which do not exhibit consistencies in their pollen records. The pit structure from Unit 48SW (Feature 4A, Sample E580, E623/624) contained large quantities of both *Euphorbia* and Gramineae pollen, suggesting the exploitation of both resources. In addition, *Typha* (cattail) pollen was observed on the floor of the pit structure, indicating the utilization of this resource, as well.

Three smaller pits or hearths (E157, E217, E623/624) yielded sufficient pollen for analysis. Two of the hearths displayed elevated *Euphorbia* pollen frequencies, while the third contained large quantities of Cheno-am and High-spine Compositae pollen. *Prosopis* pollen was recovered from one hearth as the only subsurface presence of this pollen. In addition, the only subsurface record of the presence of Cruciferae pollen in this area was obtained from the hearths. The presence of Cruciferae pollen in all of the hearth samples and its absence from all other samples suggests that a member of this family was processed in the hearths.

A cumulative list of native plants utilized by the occupants of this site includes Cheno-ams (*Atriplex* and possibly *Chenopodium* and/or *Amaranthus*, High-spine Compositae, Cruciferae, *Euphorbia*, Gramineae, *Prosopis*, *Shepherdia*, and *Typha*. This is suggestive that the inhabitants of this area exploited several environmental zones, including at least the West Mesa Zone in which they lived, the Leeward Slope Zone, the Riverine Zone, and the Mountain Zone as described by O'Laughlin (1980).

TABLE H-1
PROVENIENCE OF POLLEN SAMPLES FROM WEST MESA

SAMPLE NO.	FEATURE NO.	RADIOCARBON DATE	PROVENIENCE	POLLEN COUNTED
Unit 45SW				
E125	3	1920±250 B.C.	Pit structure	Insuff
Unit 45SE				
E157	4		Pit	100
E158	10A	1015±230 B.C.	Pit 80 x 60 cm	100
E176	12		Pit, present ground surface	200
E179	12	115±20 A.D. 210±70 A.D.	Pit, lower pit fill	100
E217	5		Pit	100
E330	18	325±60 A.D. 180±50 A.D.	Pit, lower fill	100
Unit 48SW				
E580	4A	760±160 A.D.	Rectangular pit structure	100
E623/624	4A	1060±160 A.D. 600±180 A.D.	Hearth in rectangular pit structure	100
Unit 21SW				
E686	4	830±200 1045±150* 1020±135*	Internal pit inside pit structure 18 cm below pit structure floor	100
Unit 50				
E696	4	530±260 B.C. 900±130	Pit structure	Insuff
Unit 75				
E706	5B	1065±195 B.C.	Exterior hearth associated with pit structure	Insuff

NOTE: *Dates from associated structure fill.

TABLE H-2

POLLEN TYPES OBSERVED IN SAMPLES FROM WEST MESA

SCIENTIFIC NAME	COMMON NAME
ARBOREAL POLLEN:	
Juniperus	Juniper
Pinus	Pine
Quercus	Oak
NON-ARBOREAL POLLEN:	
Caryophyllaceae	Pink Family
Cheno-ams	Includes amaranth and pigweed family
Compositae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes snakeweed, sunflower, etc.
Cruciferae	Mustard family
Ephedra	Joint fir
Eriogonum	Wild buckwheat
Euphorbia	Spurge
Gramineae	Grass family
Labiatae	Mint family
Nyctaginaceae	Four o'clock family
Prosopis	Mesquite
Rosaceae	Rose family
Cercocarpus	Mountain mahogany
Saxifragaceae	Saxifrage family
Shepherdia	Buffaloberry
Typha angustifolia/*Sparganium*	Cattail/burreed

REFERENCES

Ammerman, A. J. and M. W. Feldman
1974 On the "Making" of an Assemblage of Stone Tools. American Antiquity 9:610-616.

Antevs, E.
1955 Geologic-climatic Dating in the West. American Antiquity. 20:317- 335.

Anyon, R.
1985 Archeological Testing at the Fairchaild Site (LA 45732) Otero County, New Mexico. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Anyon, R. and S. A. LeBlanc
1984 The Galaz Ruin. A Prehistoric Mimbres Village in Southwestern New Mexico. University of New Mexico Press, Albuquerque.

Arizona State Museum
1984 A comprehensive plan for the management of cultural resources in the Santa Teresa study area. Compiled by Cynthia Irwin-Williams, Fred Nials, John C. Ravesloot, Lyle M. Stone and Lynn S. Teaque. Cultural Resource Management Division, Arizona State Museum, University of Arizona.

Ascher, R.
1968 Time's Arrow and the Archaeology of a Contemporary Community. In Settlement Archaeology, edited by K.C. Chang, pp. 43-52. National Press Books, Palo Alto.

Baker, C.
1978 The Size Effect: An Explanation of Variability in Surface Artifact Assemblage Content. American Antiquity 43:288-293.

Bandelier, A. F.
1890-1892 Final report of investigations among the Indians of the southwestern United States carried on mainly in the years from 1880 to 1885, Part I. Papers of the Archaeological Institute of America, American Series, Vols. III & IV Cambridge: John Wilson & Sons.

1892 Final report of investigations among the Indians of the southwestern United States carried on mainly in the years from 1880 to 1885, Part II. Papers of the Archaeological Institute of America, American Series III & IV.

Bandelier, A. F., Editor
1922 The Journey of Alvar Nunez Cabeza de Vaca. Translated and edited by Fanny Bandelier. Allerton Book Co., New York.

Bartlett, J. R.
1856 Personal narrative, 2 vols. D. Appleton and Company, New York.

Basehart, H. W.
1959 Chiricahua Apache subsistence and socio-political organization, Sections I and II of a report of the Mescalero-Chiricahua Land Claims Project, Contract Research No.290-154.

Batcho, D. G., D. L. Carmichael, M. Duran and M. Johnson
1985 Archaeological Investigations of Sites Located At the Southern Dona Ana County Airport, Santa Teresa, New Mexico. Cultural Resource Management Division, Department of Sociology and Anthropology, New Mexico State University, Las Cruces, Report No.533.

Batcho, D. G. and Others
1985 Archaeological investigations of sites located at the Dona Ana County, Airport, Santa Teresa, New Mexico, Cultural Resources Management Division Report 590. Las Cruces, New Mexico: New Mexico State University.

Beckes, M. R.
1977 Descriptive analysis of projectile points. In a cultural resource

inventory and assessment of McGregor guided missile range, Otero County, New Mexico, Part II: special archaeological studies, pp. 3-39. Texas Archaeological Survey Research Report 65. Austin, Texas: The University of Texas at Austin.

Beckes, M. R.
1977 Prehistoric cultural stability and change in the southern Tularosa Basin. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh.

Beckes, M. R., D. S. Dibble, and M. D. Freeman
1977 A Cultural Resource Inventory and Assessment of McGregor Guided Missile Range, Otero County, New Mexico. Part I: The Cultural Resource Base. Texas Archaeological Survey Research Report No. 65/I. The University of Texas at Austin.

Beckes, M. R., A. R. Dulaney, J. D. Pigott, R. F. Scott IV, N. K. Smiley
1977 A Cultural Resource Inventory and Assessment of McGregor Guided Missile Range, Otero County, New Mexico. Part II: Special Archaeological Studies. Texas Archaeological Survey Research Report No. 65/II. University of Texas at Austin.

Beckett, P. H.
1973 Cochise culture sites in south central and north-central New Mexico. Unpublished M.A. thesis. Portales, New Mexico: Eastern New Mexico University.

Beckett, P. H. (continued)
1980 Dune Movement. In the Ake Site: Collection and Excavation of LA 13423, Catron County, New Mexico, by Patrick Beckett, pp. 121-134. New Mexico State University Cultural Resources Management Division Report 357.

Binford, R.
1981 Behavioral archaeology and the "Pompeii premise." Journal of Anthropological Research 37:195-208.

Binford, L. R.
1978a Nunamiut Ethnoarchaeology. Academic Press, New York.

1978b Dimensional analysis of behavior and site structure: learning from an Eskimo hunting stand. American Antiquity 43:330-361.

1979 Organization and Formation Processes: Looking at Curated Technologies. Journal of Anthropological Research 35:255-273.

1980 Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. American Antiquity 45:4-20.

1982 The archaeology of place. Journal of Anthropological Archaeology 1:5-31.

Binford, L.R. and J.A. Sabloff
1982 Paradigms, systematicvs, and archaeology. Journal of Anthropological Research 38(2):137-153.

Bolton, H. E.
1930 Anza's California expedition. Berkeley, California.

1952 Spanish exploration in the Southwest. New York.

Bradley, R. J. E.
1983 La Cabrana: A study of Fourteenth Century Resource Utilization in Southern New Mexico. M.A. Thesis. Department of Anthropology, University of Texas, El Paso.

Brook, V. R.
1984 The Bob John's Site. Salvage results at an El Paso Phase village. To be published in the Transactions of the Southwest Federation of Archaeological Societies Papers.

Bryant, V. M. Jr. and D. A. Larson
1986 Pollen analysis of the Devil's Mount site, Val Verde Texas. The Devil's Mouth Site, the third season -- 1967.

Papers of the Texas Archaeological Salvage Project 14:57-70.

Bryant, V. M., Jr.
1977 Late Quaternary pollen records from the east-central periphery of the Chihuahuan Desert. In Transactions of the symposium on the Biological sources of the Chihuahuan Desert Region, United States and Mexico, edited by R.H. Wauer and D. H. Riskind, U. S. Department of the Interior, National Park Service Transactions and Proceedings Series 3.

Bulloch, H. E., Jr. and R. E. Neher
1980 Soil survey of Dona Ana County area of New Mexico. United States Department of Agriculture, Soil Conservation Service.

Bye, R. A., Jr.
1972 Enthobotany of the Southern Paiute Indians in the 1870's: With a Note on the Early Ethnobotanical Contributions of Dr. Edward Palmer. Desert Research Institute Publications in the Social Sciences, No.8

Camilli, E. L.
1983 Site occupational history and lithic assemblage structure: an example from southeastern Utah. Ph.D. dissertation. Department of Anthropology, University of New Mexico.

Camilli, E. L. and M. Nelson
1983 In-field lithic analysis codes, Ladder Ranch Field School. Department of Anthropology, University of New Mexico, Albuquerque.

Carmichael, D.
1981 Non-residential occupation of the prehistoric southern Tularosa Basin, New Mexico. In Michael S. Foster, editor, Archaeological Essays in Honor of Mark Wimberly, pp. 51-68. The Artifact Vol. 19, Nos. 3-4. El Paso Archaeological Society.

1983 Archaeological Settlement Patterns in the southern Tularosa Basin, New Mexico: Alternative Models of Prehistoric Adaptations. Ph.D. dissertation. University of Illinois at Urbana-Champaign. University Microfilms, Ann Arbor.

1983b Archaeological survey of the southern Tularosa Basin, New Mexico. A report prepared for the Environmental Office, Directorate of Facilities Engineering, Fort Bliss, Texas: Fort Bliss Air Defense Center.

1984 Possible archaeological evidence for non-linear culture change in the southern Tularosa Basin, New Mexico. In Upham, Steadman, Fred Plog, David G. Batcho and Barbara E. Kauffman, editors, Recent Research in Mogollon Archaeology, pp. 13-27. Occasional Papers No.10 University Museum, New Mexico State University, Las Cruces.

1985a Traditional Pueblo Occupation on Dona Ana Range, Fort Bliss, New Mexico. In Beck, Coleen M., editor, Views of the Jornada Mogollon, pp. 45-53. Eastern New Mexico University Contributions in Anthropology, Vol. 12, Portales.

1985b Pithouse to Pueblo Transition in the Jornada Mogollon: A Reappraisal. In Foster, Michael S. and Thomas C. O'Laughlin, editors, Proceedings of the Third Jornada-Mogollon Conference, The Artifact 23(1-2). El Paso Archaeological Society.

1985c Archaeological Excavations at Two Prehistoric Campsites Near Keystone Dam, El Paso, Texas. University Museum Occasional Papers No. 14, New Mexico State University, Las Cruces.

Castetter, E. F. and W. H. Bell
1942 Pima and Papago Indian Agriculture. The University of New Mexico Press, Albuquerque.

1951 Yuman Indian Agriculture. University of New Mexico Press, Albuquerque.

Chamberlin, R. V.
1915 The Ethnobotany of the Gosiute Indians of Utah. American Anthropological Association Memoirs, 2:329-405.

Chapman, R. C.

1977 Analysis of the Lithic Assemblages. In Settlement and Subsistence Along the Lower Chaco River, edited by Charles A. Reher, pp. 371- 452. University of New Mexico Press, Albuquerque.

Colton, H. S.

1974 Hopi History and Ethnobotany. In Hopi History. Garland Publishing Inc., New York.

Cordell, L. S.

1979 Prehistory: Eastern Anasazi. In Handbook of North American Indians, Vol. 9: 131-151, edited by Alfonso Ortiz. Smithsonian Institution, Washington, D. C.

Cowgill, G. L.

1975 A selection of samplers: comments on archaeo-statistics. In Sampling in Archaeology, edited by James W. Mueller, pp. 258-274. University of Arizona Press, Tucson.

Cushing, F. H.

1920 Zuni Breadstuff. Indian Notes and Monographs, Vol. VIII. Museum of the American Indian, Heye Foundation, New York.

Davis, J. V.

1975 A Paleo-Indian point from Hueco Firing Range, Otero County, New Mexico. The Artifact 13(1). El Paso Archaeological Society.

Davis, J. O., F. Nials, and J. C. Ravesloot

1985 Environmental setting and Geomorphology of the Study Area. In Archaeological Resources of the Santa Teresa Study Area, South-central New Mexico, edited by Jon C. Ravesloot. M.S. on file Cultural Resource Management Division, Arizona State Museum, University of Arizona.

DeBoer, W.

1980 Vessel Shape from Rim Sherds: an Experiment on the Effect of the Individual Illustrator. Journal of Field Archaeology 7:133-135.

Denton, G. H. and S. C. Porter

1970 Neoglaciation. Scientific American 222:101-110.

Dick-Peddie, W. A.

1965 Changing vegetation patterns in southern New Mexico. In Guidebook of Southwestern New Mexico II, pp. 234-235, edited by Fitzsimmons, J. P., and C. L. Lochman-Blak. New Mexico Geological Society, 16th Field Conference.

1975 Vegetation of southern New Mexico. In Guidebook of the Las Cruces Country, pp. 81-84, edited by Seager, W. R; Clemons, R.;and Callender, J. F. New Mexico Geological Society, 26th Field Conference.

Dominick, D.

1936 The Sheepeaters. Annals of Wyoming 36:131-168.

Drucker, P.

1937 Cultural element distribution: V. Southern California. University of California Publications: Anthropological Records 1(1). Berkeley.

Dunnell, R. C. and W. S. Dancey

1983 The siteless survey: A regional scale data collection strategy. In Schiffer, M. B., ed., Advances in Archaeological Method and Theory, Vol. 5. Academic Press, New York.

Ebert, J. I., S. Larralde, and L. Wandsnider

1983 Distributional Archaeology: Survey, Mapping and Analysis of Surface Archaeological Materials and Their Landform Associations in the Green River Basin, Wyoming. Paper presented at the 1983 Plains Conference, Rapid City, South Dakota, November 2-5, 1983.

1984 Predictive Modeling: Current Abuses of Archaeological Record and Prospects for Explanation. Paper presented at the 49th Annual meeting of the Society for American Archaeology, April 14, Portland, Oregon.

Ebert, J. I.
1983 Request for Proposal No. 7029-3-0015: Cultural Resources Sample Survey in the Seedskadee Cultural Resource Assessment Project Area, Southwestern Wyoming. Santa Fe, NM: US Department of the Interior, National Park Service. Manuscript on file at Branch of Remote Sensing, National Park Service, P.O. Box 26176, Albuquerque, NM 87126-6176.

Eidenbach, P. L. and M. Wimberly
1980 Archaeological reconnaissance in White Sands National Monument. Human Systems Research, Inc., Tularosa, New Mexico.

Ellis, F. H.
1974 Archaeologic and ethnologic data: Acoma-Laguna land claims. In *Pueblo Indians*, Vol. II. Garland Publishing, New York.

Elmore, F. H.
1944 Ethnobotany of the Navajo. *Monographs of the School of American Research*, No. 8, Santa Fe .

Emory, W. H.
1948 Notes of a Military Reconnaissance. *Ex. Doc. No. 41.* Washington, D. C.: 1848.

Euler, R. C. and C. S. Fowler
1966 Southern Paiute ethnohistory. *University of Utah Anthropological Papers* No. 78, Glen Canyon Series No. 28. Salt Lake City.

Farrer, R., R. Polka, and M. Selinfreund
1983 Predictions of annual underground temperature profiles for thirty New Mexico locations. Manuscript on file at the New Mexico Solar Energy Institute, New Mexico State University.

Fish, P. R.
1978 Consistency in Archaeological Measurement and Classification: A Pilot Study. *American Antiquity* 43 (1):86-88.

Fields, R. C. and J. S. Girard
1983 Investigations at Site 32 (41EP325), Keystone Dam Project. Reports of Investigations, Number 21. Prewitt and Associates, Inc. Submitted to U.S. Army Corps of Engineers, Albuquerque District.

Foley, R. A.
1980 The spatial component of archaeological data: Off-site methods and some preliminary results from the Amboseli Basin, Southern Kenya. Proceedings of the VIII PanAfrican Congress in Prehistory and Quaternary Studies, pp. 39-40.

Foley, R. A.
1981a Off-site archaeology: An alternative approach for the short-sited. In Hodder, I., G. Isaac, and N. Hammond, eds., *Patterns of the Past: Essays in Honor of David L. Clarke*, pp. 157-183. Cambridge: Cambridge University Press.

1981b Off-site archaeology and human adaptation in eastern Africa: An analysis of regional artifact density in the Amboseli, southern Kenya. *Bar International Series 97 (Cambridge Monographs in African Archaeology 3).* Oxford, England: British Archaeological Reports. 256 pp.

Forsythe, G. E., M. A. Malcom, and C. B. Moler
1977 *Computer Methods for Mathematical Computations.* Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

1979 *Computer for Computations.* Prenctice-Hall, Inc., Englewood Cliffs, New Jersey

Fowler, D. D. and C. S. Fowler
1971 Anthropology of the Numa: John Wesley Powell's manuscripts on the Numic Peoples of western North America. *Smithsonian Contributions to Anthropology 14.*

Foster, Michael S. and Ronna J. Bradley
1983 La Cabrana: A Preliminary Discussion of a Jornada Mogollon Pueblo. Manuscript on file at the El Paso Centennial Museum, University of Texas at El Paso.

Freeman, C. E.
1972 Pollen study of some Holocene deposits in Dona Ana County, southern New Mexico. The Texas Journal of Science 23:2-3-220.

Fried, J.
1952 Ideal norms and social control in Tarahumara society. 6, 297 l. illus., map. Dissertation (Anthropology)--New Haven, Yale University, 1952. (m)

Gallagher, M. V.
1977 Contemporary Ethnobotany Among the Apache of the Clarkdale, Arizona Area, Coconino and Prescott National Forests. Archaeological Report No. 14. USDA Forest Service, Southwestern Region, Albuquerque.

Gifford, E. W.
1934 The cocopa. University of California Publications in American Archaeology and Ethnology 31:257-334.

Gile, L. H.
1966 Coppice dunes and the Rotura soil. Soil Science Society, American Proceedings 657-660.

Gile, L. H. and R. B. Grossman
1979 The Desert Project Soil Monograph. Soil Conservation Service, U. S. Department of Agriculture.

Gile, L. H., J. W. Hawley, and R. B. Grossman
1981 Soils and geomorphology in the Basing and Range area of southern New Mexico--Guidebook to the Desert Project. New Mexico Bureau of Mines and Mineral Resources Memoir 39.

Gillespie, A. R.
1980 Digital Techniques of Image Enhancement. In Siegel, B.S. and A. R. Gillespie, eds., Remote Sensing in Geology, pp. 162-163. John Wiley, New York.

Goodyear, A. C.
1979 A Hypothesis for the Use of Cryptocrystalline Raw Materials among Paleo-Indian Groups of North America. University of North Carolina Research Manuscript Series No. 156.

Gould, R. A.
1968 Living archaeology: The Ngatatjara of the Western Australian Desert. Southwestern Journal of Anthropology 24: 101-122.

1980 Living archaeology. Cambridge University Press, Cambridge.

Gould, R. A., D. A. Koster, and A. H. L. Sontz
1971 The Lithnic Assemblage of the Western Desert Aborigines of Australia. American Antiquity 39:147-169.

Hackenburg, R. A.
1974 Pima-Maricopa Indian. Volume I: Aboriginal land use and occupancy of the Pima-Maricopa Indians. Garland Publishing Inc., New York.

Hafsten, U.
1961 Pleistocene development of vegetation and climate in the southern High Plains as evidenced by pollen analysis. In Paleoecology of the Llano Estacado, edited by F. Wendorf, pp. 59-91. Fort Burgwin Research Center Publications No. 1.

Hammond, G. P. and Rey, A.
1929 The Espejo expedition into New Mexico made by Antonio de Espejo, 1582-1583, as revealed by the journal of Diego Perea de Luxan. Quivira Society Publications I, Los Angeles.

1953 Don Juan de Onate, colonizer of New Mexico, 1595-1628. Coronado Historical Series, Vols. V-VI, Albuquerque.

1966 The rediscovery of New Mexico 1580-1594 (The explorations of

Chamuscado, Espejo, Casteno de Sosa, Morlete and Layva de Bonilla and Humana). University of New Mexico Press, Albuquerque.

Hard, R. J.

1983a The Mesilla phase near El Paso, Texas and Southwestern Agricultural Dependence. MS on file, Department of Anthropology, University of New Mexico.

1983b Excavations in the Castner Range Archaeological District in El Paso, Texas. Publications in Archaeology No. 11. El Paso Centennial Museum, University of Texas at El Paso.

Harrington, H. D.

1967 Edible Native Plants of the Rocky Mountains. University of New Mexico Press, Albuquerque.

Hawley, J. W.

1965 Geomorphic surfaces along the Rio Grande Valley from El Paso, Texas to Caballo Reservoir, New Mexico. In Guidebook of Southwestern New Mexico II, pp. 188-198, edited by J.P. Fitzsimmons, J. P. and C. L. Lochman-Balk. New Mexico Geological Society, 16th Field Conference.

1975 Quaternary history of Dona Ana County region, south-central New Mexico. In Guidebook of the Las Cruces Country, pp. 139-150, edited by Seager, W. R., Clemons, R., and Callender, J. F. New Mexico Geological Society, 26th Field Conference.

Hawley, J. W. and F. E. Kottlowski

1969 Quaternary geology of the south-central New Mexico border region. New Mexico Bureau of Mines and Mineral Resources, Circular 104: 89- 115. Socorro, New Mexico.

Hawley, J. W., W. S. Strain, W. R. Seager, W. E. King, and D. V. LeMone.

1969 The Santa Fe Group in south-central New Mexico border region. New Mexico Bureau of Mines and Mineral Resources, Circular 104: 52-76, Socorro, New Mexico.

Heinsch, L.

1980 An archaeological clearance survey of nine hydrocarbon testing transects in southern Dona Ana County. Cultural Resource Management Division, Department of Sociology and Anthropology, New Mexico State University, Report No. 374, Las Cruces, New Mexico.

Heizer, R. F.

1970 Ethnographic notes on the Northern Paiute of the Humboldt Sink, west central Nevada. In Languages and Cultures of Western North America, edited by Earl H. Swanson, Jr., pp. 232-245. Idaho State University Press, Pocatello.

Hickes, P. A.

1985 Results of Analysis: Lithics. In Archaeological Resource of the Santa Teresa Study Area, South-central New Mexico, edited by John C. Ravesloot. MS. on file, Arizona State Museum, University of Arizona, Tucson.

Hilley, J.

1981 407 miles of archaeological transect sampling in the basins of southern New Mexico, Vols. I and II. Cultural Resource Management Division, Department of Sociology and Anthropology, New Mexico State University, Report No. 475, Las Cruces, New Mexico.

Hitchcock, R. K.

1982 The ethnoarchaeology of sedentism: mobility strategies and site structure among foraging and food producing populations in the Eastern Kalabari Desert, Botswana. Ph.D. Dissertation, Albuquerque, New Mexico: Department of Anthropology, University of New Mexico.

Hodge, F. W., Hammond, G. P. and Rev, A.

1985 Fray Alonso de Benavides' revised memorial of 1634. Coronado Historical Series Vol. IV. Albuquerque.

Hoffman, R. S. and J. K. Jones, Jr.

1970 Influence of late-glacial and

post-glacial events on the distribution of recent mammals of the northern Great Plains. In Pleistocene and Recent environments of the Central Great Plains, edited by W. Dort, Jr. and J. K. Jones, Jr, pp.335-394. Department of Geology, University of Kansas Special Publication 3, University of Kansas, Lawrence.

Hofman, J. L. and C. A. Morrow
1984 Chipped Stone Technologies at Twenhafel: A Multicomponent Site in Southern Illinois. In Lithic Resource Procurement: Proceedings from the Second Conference on Prehistoric Chert Exploitation, edited by Susan C. Vehik, Center for Archaeological Investigations, Occasional Paper 4.

Hultkrantz, A.
1970 The source literature on the "Tukudika" Indians in Wyoming: facts and fancies. In Languages and Cultures of Western North America, edited by Earl H. Swanson, Jr., pp. 246-264. Idaho State University Press, Pocatello.

1974 The Shoshones in the Rocky Mountain area. In Shoshone Indians, pp. 173-214. Garland Publishing Company, New York.

Human Systems Research
1973 Technical Manual, 1973 Survey of the Tularosa Basin. Human Systems Research, Tularosa, New Mexico.

Hunt, C. B.
1974 Natural regions of the United States and Canada. W. H. Freeman and Company, San Francisco.

Ingbar, E., S. Larralde, and L. Wandsnider.
1983 A Technical Proposal for a Cultural Resources Sample Survey in the Seedskadee Cultural Resources Assessment Project Areas, Southwestern Wyoming, RFP No. 7029-3-0015. Prepared for the US Department of the Interior by Chambers Consultants and Planners, 2051 Yale Blvd. SE, Albuquerque, NM 87106.

Irwin-Williams, C.
1979 Post-pleistocene archaeology, 700-2000 B. C. In Handbook of North American Indians, Vol. 8, Southwest. Smithsonian Institution, Washington, D. C.

1984 Appendix A. Hunter-Gatherer Culture Change and the Development of Sedentism in the Southwest U.S. Phase I 1981-1983: Progress Report. In A Comprehensive Plan for the Management of Cultural Resources in the Santa Teresa Study Area. Compiled by Cynthia Irwin-Williams, Teague. Cultural Resource Management Division Arizona State Museum, University of Arizona.

Isaac, G. and J. W. K. Harris
1975 The scatter between the patches. Paper presented to the Kroeber Anthropological Society, May 1975.

Janes, R. R.
1983 Archaeological Ethnography among Mackenzie Basin Dene, Canada. Arctic Institute of North American Technical Paper 28.

Johnson, L., Jr.
1963 Pollen analysis of two archaeological sites at Amistad Reservoir, Texas. Texas Journal of Science 15:225-230.

Joseph, A., R. B. Spicer and J. C.
1949 The desert people, a study of the Papago Indians of southern Arizona. University of Chicago Press, Chicago.

Kearney, T. H., R. H. Peebles, and collaborators
1960 Arizona Flora. University of California Press, Berkeley.

Kelly, I. T.
1934 Ethnography of the Surprise Valley Paiute. University of California Publications in American Archaeology and Ethnology 31(3):67-210, pl. 17-22. Berkeley.

1964 Southern Paiute ethnography. Anthropological Papers of the University of Utah 69. Salt Lake City.

Kelley, K. B.

1982 Anasazi and Navajo Land Use in the McKinley Mine Area Near Gallup, New Mexico, Volume 2: Navajo Ethnohistory. Albuquerque, New Mexico: Office of Contract Archaeology, University of New Mexico.

Kenmotsu R. D. and J. D. Pigott

1977 Part III: Botanical and Geological Studies. In A Cultural Resource Inventory and Assessment of McGregor Guided Missile Range. Texas Archeological Survey Research Report 65.

Kinnaird, L.

1953 The frontiers of New Spain, Nicolas de Lafora's description 1766-1768. Quivira Society Publications 13. The Quivira Society, Berkeley.

Kirkpatrick, D. T.

1982 Excavations of five sites on the West Mesa Dona Ana County, New Mexico. Cultural Resources Management Division Report No. 495, New Mexico State University, Las Cruces, New Mexico.

Kottlowski, F. E.

1953 Tertiary-quaternary sediments of the Rio Grande in southern New Mexico. In New Mexico Geological Society Guidebook of Southwestern New Mexico, pp. 144-148.

1958 Geologic history of the Rio Grande near El Paso, in Franklin and Hueco Mountains, Texas. West Texas Geological Society Guidebook.

Krone, M. F.

1975 A report on Folsom points found in the El Paso area. The Artifact 13(4):1-19. El Paso, Texas: El Paso Archaeological Society.

1976 A report on Folsom points found in the El Paso area. The Artifact 14(2). El Paso, Texas: El Paso Archaeological Society.

Laird, C.

1976 The Chemehuevis. Malaki Museum Press, Banning, California

Laumbach, K. W.

1982 An archaeological survey of 150 miles of seismic testing transects in Sierra and Dona Ana Counties, New Mexico. Report No. 518, Cultural Resource Management Division, Department of Sociology and Anthropology, New Mexico State University, Las Cruces.

LeBlanc, S. A. and M. E. Whalen

1980 An Archeological Synthesis of South-Central and Southwestern New Mexico. Office of Contract Archeology, University of New Mexico, Albuquerque.

Leftwich, K. and M. Proper

1983a Archaeological clearance report for Grant Geophysical Corporation Line G-5.

1983b Archaeological clearance report for Grant Geophysical Corporation Line I-5 (presented in 4 segments).

1984 Archaeological clearance report for Grant Geophysical Corporation Line GG-5. (Agency for Conservation Archaeology Reports F 84-697, F 84-205, F 84-191) Eastern New Mexico University, Portales.

Lehmer, D. J.

1948 The Jornada branch of the Mogollon. University of Arizona Social Science Bulletin 17. University of Arizona, Tucson.

Malouf, C.

1974 The Gosiute Indians. In Shoshone Indians, pp. 25-172. Garland Publishing Company, New York.

Manners, R. A.

1974 Southern Paiute and Chemehuevi: An ethnohistoric report. In Paiute Indians I, edited by D. A. Horr, pp.

29-300. Garland Publishing Company, New York.

Martin, P. S.
1963 The Last 10,000 years, a Fossil Record of the American Southwest. University of Arizona Press, Tucson.

Mehringer, P. J.
1967 Murray Springs, a mid-post glacial pollen record from southern Arizona. American Journal of Science 265:786-797.

Mehringer, P. and C. V. Haynes
1965 The pollen evidence for the environment of early man and extinct mammals at the Lehner mammoth site, southeastern Arizona. American Antiquity 31:17-23.

Mera, H. P.
1931 Chupadero Black on White. Technical Series, Bulletin No. 1. Laboratory of Anthropology, Santa Fe.

Michels, J. W. and C. Bebrich
1971 Obsidian hydration dating. In Dating Techniques for the Archaeologist. H. N. Michael and E. K. Ralph, editors. MIT Press, Cambridge.

Michels. J. W., I. Tsong, and G. Smith
1983 Experimentally derived hydration rates in obsidian dating. Archaeometry 25:107-117.

Moore, B. M.
1979 Pueblo isolated small structure sites. Ph.D. Dissertation, Department of Anthropology, Southern Illinois University, Carbondale.

Moore, J. L. and G. Bailey.
1980 An archaeological survey in a portion of the Mesilla Bolson, southwestern New Mexico. Office of Contract Archaeology, The University of New Mexico.

1981a Off-site archaeology: An alternative approach for the short-sited. In Hodder, I., G. Issac, and N. Hammond, eds., Patterns of the Past: Essays in Honor of David L. Clarke pp. 157-183. Cambridge: Cambridge University Press.

1981b Off-site archaeology and human adaptation in eastern Africa: An analysis of regional artifact density in the Amboseli, southern Kenya. BAR International Series 97 (Cambridge Monographs in African Archaeology 3). Oxford, England: British Archaeological Reports. 256 pp.

Murdock, G. P.
1967 Ethynographic Atlas. University of Pittsburgh Press.

Murphy, R. F. and Y. Murphy
1960 Shoshone-Bannock Subsistence and Society. University of California Anthropological Records 16:293-338.

Newell, R. R.
1987 Reconstruction of the Partitioning and Utilization of Outside Space in a Late Prehistoric/Early Historic Inupiat Village. In Method and Theory for Activity Area Research: An Ethnoarchaeological Approach, edited by Susan Kent, pp. 107-175. Columbia Press, New York.

O'Brien, M. J., R. D. Mason, D. E. Lewarch, and J. A. Neely
1982 A Late Formative Irrigation Settlement below Monte Alban: Survey and Excavation on the Xoxocotlan Piedmont, Oaxaca, Mexico. Institute of Latin American Studies, University of Texas, Austin.

O'Laughlin, T. C.
1979 Excavations at the Transmountain Campus, El Paso Community College, El Paso, Texas. Publication in Anthropology No. 7, El Paso Centennial Museum, The University of Texas at El Paso.

1980 The Keystone Dam Site and Other Archaic and Formative Sites in Northwest El Paso, Texas.

Publications in Anthropology No. 8, El Paso Centennial Museum, The University of Texas at El Paso.

O'Laughlin, T. C. and M. S. Foster
1981 The Roth Site: A Pithouse Site in the Mesilla Valley of Southern New Mexico. In Michael S. Foster, editor, Archaeological Essays in Honor of Mark Wimberly, pp. 133-150. The Artifact, Vol. 19, Nos. 3-4. El Paso Archaeological Society.

Pennington, C. W.
1963 The Tarahumar of Mexico; the environment and material culture. University of Utah Press, Salt Lake City, Utah. 9,267p. illus., maps.

Pierce, C. and S. R. Durand
1985 Prehistoric Land-Use and Spatial Patterning in the Mesilla Bolson.

Plog, F.
1981 Predicting cultural resources. Managing Archaeology: A Background Document for Cultural Resource Management Report No. 1, pp. 29-41. U.S. Forest Service, Southwestern Region.

Plog, S.
1985 Estimating Vessel Orifice Diameters: Measurement Methods and Measurement Error. In Decoding Prehistoric Ceramics, edited by Ben A. Nelson, pp. 243-253. Southern Illinois University Press, Carbondale.

Plog, S., F. Plog, and W. Wait
1978 Decision Making in Modern Surveys. Advances in Archaeological Method and Theory 1:383-421.

Powell, S. L.
1980 Material cultural and behavior: A prehistoric example for the American Southwest. Ph.D. dissertation, Department of Anthropology, Arizona State University, Tempe.

Ravesloot, J. C.
1984 A preliminary report for the Santa Teresa Project. Cultural Resources Management Division, Arizona State Museum, University of Arizona.

1985a Results of the Survey. In Archaeological Resources of the Santa Teresa Study Area, South-Central New Mexico, edited by John C. Ravesloot. MS. on file Cultural Resource Management Division, Arizona State Museum, University of Arizona.

1985b The Santa Teresa Project: Temporary use sites of the Mesilla Bolson, southern New Mexico. Paper presented at the Fourth Jornada Mogollon Conference, Tularosa, NM October 10-12, 1985.

Ravesloot, J. C. and C. Irwin-Williams
1985 Methodology. In Archaeological Resources of the Santa Teresa Study Area, South-Central New Mexico, edited by John C. Ravesloot. Ms. on file, Cultural Resource Management Division, Arizona State Museum, University of Arizona.

Reid, L. W.
1972 A history of the education of the Ute Indians, 1847-1905. Ph.D. dissertation, Department of Educational Administration, University of Utah, Salt Lake City.

Riddell, F. A.
1960 Honey Lake Paiute ethnography. Nevada State Museum Anthropology Papers 4. Carson City, Nevada.

Rinaldo, J. B.
1974 Playas Red. In Casas Grande: A Fallen Trading Center of the Gran Chichmeca, Vol. 6, by Charles C. Di Peso, John B. Rinaldo, and Gloria J. Fenner, pp. 147-160. The Amerind Foundation, Inc., Dragoon and the Northland Press, Flagstaff.

Robbins, W. W., J.P. Harrington, and B. Freire-Marreco
1916 Ethnobotany of the Tewa Indians. Bureau of American Ethnology Bulletin 55. Government Printing Office, Washington, D.C.

Rodney, A. B. and D. Sabo

1980 A preliminary biological assessment of the proposed south Dona Ana County airport site (New Mexico). In Environmental Assessment of the South Dona Ana County Airport, New Mexico. MS. on file with Department of Transportation, FAA.

Roth, G.

1981 Incorporation and changes in ethnic structure the Chemehuevi Indian. Ph. D. dissertation, Department of Anthropology, Northwestern University, Evanston, Illinois.

Ruhe, R. V.

1962 Age of the Rio Grande Valley in New Mexico. Journal of Geology 70:151-167.

1964 Landscape morphology and alluvial deposits in southern New Mexico. Annals, Association of American Geographers 54:147:160.

1967 Geomorphic surfaces and surficial deposits in southern New Mexico. Bureau of Mines and Mineral Resources Memoir 18.

Runyon, J. W. and J. A. Hedrick

1973 Pottery Types of the SWFAS Area. Transactions of the Eighth Regional Archeological Symposium for Southeastern New Mexico and Western Texas, pp.19-45. Lea County Archeological Society.

Russel, F.

1908 The Pima Indians. Twenty-sixth Annual Report of the Bureau of American Ethnology Smithsonian Institution, Government Printing Office, Washington, D. C.

Russell, P.

1968 Folsom Complex near Orogrande, New Mexico. The Artifact 6(2): 11-16. El Paso Archaeological Society.

Sando, J.

1979 Jemez Pueblo. In Handbook of North American Indians, Vol 9: 418-429, edited by Alfonso Ortiz, Smithsonian Institution, Washington, D. C.

Sarle, W. S.

1982 Introduction to SAS clustering procedures. In Statistical Analysis System User's Guide: Statistics (1982 edition), pp. 418-422. SAS Institute Inc., Carey, North Carolina.

SAS Institute, Inc.

1982 SAS User's Guide: Statistics. SAS Institute, Inc., Carey, North Carolina.

Scarborough, V.

1983 Anapra Pueblo site. MS. on file at the El Paso Centennial Museum, El Paso, Texas: University of Texas at El Paso.

Schianger, S. H.

1981 Tool caching behavior and the archaeological record. Paper presented at the 46th annual meetings of the Society for American Archaeology, San Diego, California.

Schiffer, M. B.

1976 Behavioral Archaeology. Academic Press, Inc., New York.

1985 Evaluating the Regional Archaeological Record. Paper presented at the 50th Annual Meeting of the Society for American Archaeology at a symposium "Issues in Archaeological Surface Survey: Meshing Method and Theory."

Schiffer, M. B., A. P. Sullivan, and T. C. Klinger

1978 The Design of Archaeolcgical Surveys. World Archaeology 10(1):1-28.

Schroeder, A. H.

1974 A Study of the Apache Indians, Part I. Garland Publishing Inc., New York.

Scott, C. J.

1983 The Evolution of Mimbres Pottery. In Mimbres Pottery, Ancient Art of the American Southwest, pp.38-67. Hudson Hills Press, New York.

Seager, W. R., F. E. Kottlowski, J. W. Hawley and W. E. King

1981 Geology of the Robledo Mountains and vicinity. New Mexico Bureau of Mines and Mineral Resources, open-file report.

Seaman, T. J.

1987 Chapter 5 Survey Methods. In *Borderstar 85 Survey*, by Timothy J. Seaman, William Doleman, and Richard Chapman. Office of Contract Archaeology, University of New Mexico. In preparation.

Seaman, T. J. and B. J. Mills

1986 What are we measuring? Rim thickness indices and their implications for changes in vessel use. Paper submitted for publication in the Proceedings of the Fourth Jornada Conference, Tularosa, New Mexico October 1985.

Shimkin, D. S.

1940 Shoshone-Comanche origins and migrations. Proceedings of the Sixth Pacific Science Conference of the Pacific Science Association 4:17- 25.

1947 Wind River Shoshone ethnography. University of California Anthropological Records 5(4). Berkeley.

Simms, S. R.

1983 The Effects of Grinding Stone Reuse on the Archaeological Record in the Eastern Great Basin. *Journal of California and Great Basin Anthropology* 5(1,2):98-102.

Steward, J. H.

1933 Ethnography of the Owens Valley Paiute. *University of California Publications in American Archaeology and Ethnology* 33(3):233-350.

1938 Basin-plateau aboriginal sociopolitical groups. *Bureau of American Ethnology Bulletin 120*. US Government Publishing Office, Washington, DC.

1940 Native Cultures of the Intermontane (Great Basin) area. In "Essays in Historical Anthropology," pp. 445-502. *Smithsonian Miscellaneous Collections 100*. Washington, DC.

Stewart, O. C.

1970 The question of Bannock territory. In *Language and Cultures of Western North America*, edited by Earl H. Swanson, Jr., pp. 201-231 Idaho State University Press, Pocatello.

Stuart, D. E., and R. P. Gauthier.

1981 *Prehistoric New Mexico, Background for Survey*. Santa Fe, New Mexico: Historic Preservation Bureau.

Simmons, M.

1979 History of Pueblo-Spanish Relations to 1821. In *Handbook of North American Indians*, Vol 9:178-193. Edited by Alfonso Ortiz, Smithsonian Institution, Washington, D. C.

Skelton, D. W., M. D. Freeman, N. K. Smiley, J. D. Pigott, and D. S. Dibble

1981 *A Cultural Resource Inventory and Assessment of Dona Ana Range, New Mexico*. Research Report No. 69, Texas Archeological Survey, University of Texas at Austin.

Spier, L.

1933 *Yuman tribes of the Gila River*. The University of Chicago Press, Chicago.

Stallings, W. S., Jr.

1931 El Paso Polychrome. *Technical Series, Bulletin No. 1*. Laboratory of Anthropology, Santa Fe.

Stevenson, M. C.

1915 Ethnobotany of the Zuni Indians. *Thirtieth Annual Report of the Bureau of American Ethnology*. Government Printing Office, Washington.

Steward, J. H.

1938 Basin-Plateau Aboriginal Sociopolitical Groups. *Bureau of American Ethnology Bulletin 120*. Washington, DC.

Strain, W. S.

1959 Blancan mammalian fauna from Rio Grande Valley. U.S. Geological Survey Water Supply Paper 141.

1966 Blancan mammalian fauna and Pleistocene formations, Hudspeth County, Texas. Texas Memorial Museum Bulletin 10, Austin, Texas.

Sullivan, A. P. and K. C. Rozen

1985 Debitage Analysis and Archaeological Interpretations. American Antiquity 50:755-779.

Taylor, M.

1981 An archaeological survey of the proposed Anapra ORV area. Report on file with the BLM Las Cruces District Office: Las Cruces, New Mexico.

Thomas, D. H.

1971 Prehistoric subsistence-settlement patterns of the Reese River Valley, central Nevada. Ph.D. dissertation, University of California, Davis. University Microfilms, Ann Arbor.

1972 A computer simulation model of Great Basin Shoshonean settlement patterns. In Models in Archaeology, edited by David L. Clarke, pp. 671-704. Methuen, London.

1973 An empirical test of Steward's model of Great Basin settlement patterns. American Antiquity 38:155-176.

1975 Nonsite sampling in archaeology: Up the creek without a site? In Mueller, J. W., ed., Sampling in Archaeology, pp. 61-81. Tucson: University of Arizona Press.

1983 The archaeology of Monitor Valley, 1. Epistomology. Anthropological Papers of the American Museum of Natural History, Vol. 58, Part 1. New York.

Thompson, M. and P. H. Beckett

1979 A study of prehistoric campsites in northeast El Paso. Cultural Resources Management Division, Department of Sociology and Anthropology Report 310. New Mexico State University.

Torrence, R.

1983 Time Budgeting and Hunter-gatherer Technology. In Hunter-gatherer Economy in Prehistory, pp. 11-23, edited by Geoff Bailey. Cambridge University Press, New York.

Titiev, M.

1937 A Hopi salt expedition. American Anthropologist 39:244-258.

Underhill, R.

1936 Autobiography of a Papago woman. American Anthropological Association, Memoir 48.

1979 Papago. Holt, Rinehart and Winston, San Francisco. (First published as "Autobiography of a Papago woman." Memoirs of the American Anthropological Association 46).

1983 Anapra Pueblo sites notes. Notes on file at the El Paso Centennial Museum, El Paso, Texas: University of Texas at El Paso.

1984 Archaeological excavations at two prehistoric campsites near Keystone Dam, El Paso, Texas. Cultural Resources Management Division Report 577, Las Cruces, New Mexico: New Mexico State University.

University of Utah

1983 IMACS Users Guide. Intermountain Antiquities Computer Systems. Salt Lake City, UT: Archeological Center, Department of Anthropology.

U.S. Department of Commerce

1985 Monthly Climatic Data for Texas. National Oceanic and Atmospheric Administration, Ashville, NC.

Van Devender, T. R.

1977 Holocene woodlands in the southwestern deserts. Science 198:189-192.

Van Devender, T. R. and D. Worthington

1977 The herpetofauna of Howell's Ridge Cave and the paleoecology of the northern Chihuahuan desert. In Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert Region, edited by R.H. Wauer and D. H. Riskind, pp. 85-106. National Park Service, Washington, D. C.

Van Devender, T. R., and F. M. Wiseman

1977 A preliminary chronology of bioenvironmental changes during the PaleoIndian period in the monsoonal Southwest. Museum Journal 17.

Van Devender, T. R., J. L. Betancourt and M. Wimberly

1984 Biogeographic implications of a packrat midden sequence from the Sacramento Mountains, south-central New Mexico. Quaternary Research 22:344-360.

Van Devender, T. R. and W. G. Spaulding

1979 Development of vegetation and climate in the southwestern United States. Science 204:701-710.

Vestal, P.

1952 Ethnobotany of the Ramah Navaho. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University Vol. XL--No. 4, Cambridge.

Wandsnider, L.

1985 Geomorphological Processes and the Integrity of Archaeological Remains in Dune Fields. Paper presented at the 50th Meeting of the Society for American Archaeology, May 3, Denver.

N.D.B. 1986A Experimental investigations of artifact behavior in Albuquerque West Mesa dune fields. In Albuquerque Archaeology: A Volume Honoring Richard Bice, edited by Carol Condie, in preparation.

N.D.A. 1986B Beyond cautionary tales: experimental approaches to the analysis of archaeological surface distributions. In Natural disturbance Processes and the Archaeological Record, edited by Michael Petraglia and David Nash, BAR Volume, in preparation.

1987A The Role of Experimentation in Natural Formation Process Research. In Natural Formation Processes, edited by Michael D. Petraglia and David T. Nash. British Archaeological Reports, International Series. Oxford, in press.

1987B Experimental Investigations of Artifact Behavior in Albuquerque West Mesa Dune Fields. In Albuquerque Archaeology: A Volume Honoring Richard Bice, edited by Carol condie, in press.

Wandsnider, L. and J. I. Ebert

1983 Modeling climatic and landform factors affecting the character of the archaeological record in arid lands: A remote sensing approach in southwestern Wyoming. Paper presented at the Silver Anniversary Meetings of the Western Social Science Association and the Association for Arid Lands Studies, April 27-30, Albuquerque, New Mexico.

1984 Accuracy in Archaeological Surface Survey in the Seedskadee Project Area, southwestern Wyoming. Haliksaa'i: UNM Contributions to Anthropology 3:9-21.

Wandsnider, L. and S. Larralde

1984 Seedskadee Cultural Resources Assessment Project: Report to the Branch of Remote Sensing, National Park Service, Santa Fe, NM. On file at the Branch of Remote Sensing, NPS, Santa Fe, NM.

Warren, A. H.

1985 Notes on the Geology and Mineral Resources of the Jarilla Mountains Area, Otero County, New Mexico. MS. on file Office of Contract

Archaeology, University of New Mexico. Albuquerque.

Whalen, M.
1985 Early Pithouse Period Research in the Hueco Bolson. In Foster, Michael S. and Thomas C. O'Laughlin, editors, Proceedings of the Third Jornada-Mogollon Conference, pp. 97-108. The Artifact 23 (1,2). El Paso Archaeological Society.

Whallon, R.
1979 An archaeological survey of the Kebran Reservoir area of east-central Turkey. University of Michigan, Museum of Anthropology, Memoirs 11.

Whiting, A. F.
1939 Ethnobotany of the Hopi. Museum of Northern Arizona Bulletin No./15, Flagstaff

1950 Paiute sorcery. Viking Fund Publications in Anthropology 15. Viking Fund, New York.

Wood, W. R. and D. L. Johnson
1978 A survey of disturbance processes in archaeological site formation. In Schiffer, Michael B., ed., Advances in Archaeological Method and Theory, Vol. I. New York: Academic Press.

Yellen, J. A.
1977 Archaeological Approaches to the Present. New York: Academic Press.

Yellen, J. E., and R. B. Lee.
1976 The Dobe/Du/da environment: background to a hunting and gathering way of life. In Kalahi hunter-gatherers, edited by Richard B. Lee and Irven DeVore, pp. 27-46. Havard University Press, Cambridge.

York, J. C. and W. A. Dick-Peddie
1969 Vegetation changes in southern New Mexico during the past hundred years. In William G. McGinnies and Bram J. Goldman, ed., Arid lands in perspective, pp. 157-166. The University of Arizona Press, Tucson.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988 — 576-821/85228

END

7 – 15 – 91